HIGH VOLTAGE AND X-RADIATION PROTECTION

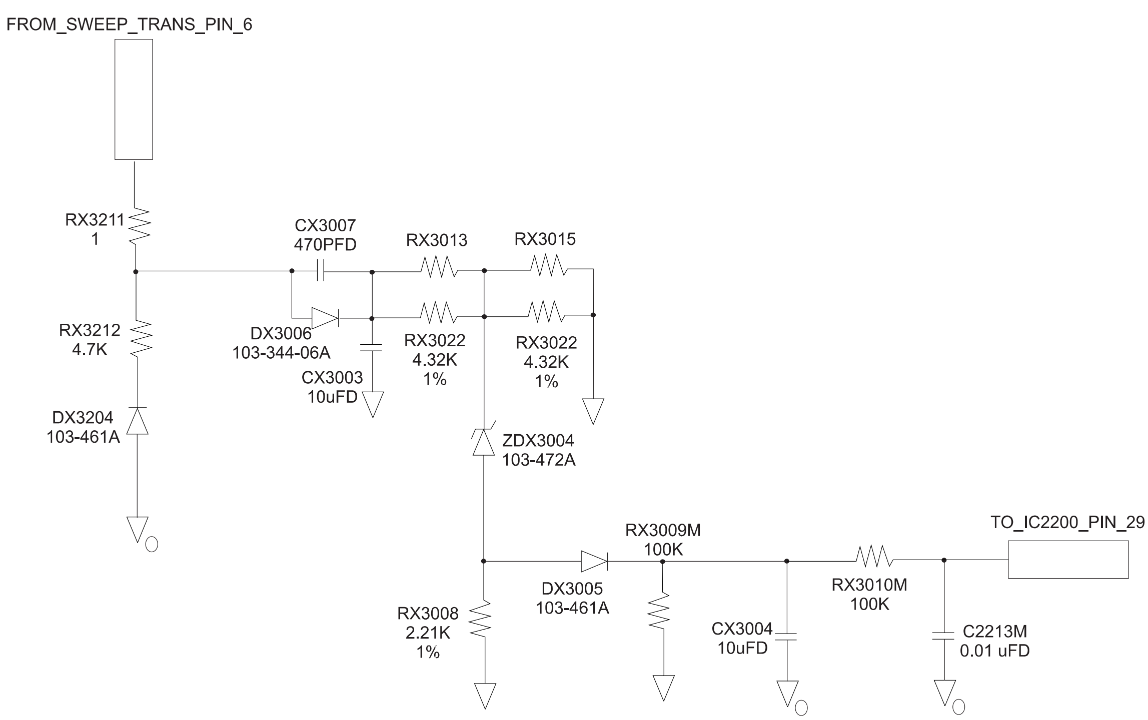
A potential source of x-rays is the picture tube, if the high voltage (HV) is out of specification. When the HV is operating properly, there is no x-radiation. For the CA chassis family, the HV has no adjustments. A HV shutdown circuit is used to prevent excessive HV and x-ray emissions.

THEORY OF OPERATION (SHUTDOWN CIRCUIT)

This circuit basically monitors the sweep pulse voltage derived from the sweep transformer TX3204 pins 5 & 6. This voltage is rectified, and applied to a 12V zener diode ZDX3004. When the HV reaches its maximum allowed ,value (see drawing) the zener diode conducts, the voltage on pin 29 of the video processor (ICX2200) increases until it reaches the threshold voltage of 3.5 VDC, and shuts down the TV. If the shutdown circuit has operated, the microcontroller will prevent the TV from being turned on again, without first having to unplug the AC cord to reset the microcontroller.

TIP: Make a momentary short between the OUTPUT and GND of the IC6002 (RESET CIRCUIT) this will reset the microcontroller IC6000. Apply signal through the video generator or tune the TV color receiver to crosshatch pattern. Connect an accurate HV meter between the picture tube anode and chassis ground. Access Video Menu and adjust Brightness and Contrast controls for minimum screen luminance. Wait until, the Video Menu or display disappear. Read HV meter.

SCREEN SIZE	B+ VDC (0 BEAM)	HV NOM KV	HV MAX KV
COMPONENT LEVEL REPAIR			
25	124.0 +/- 2%	27	29
27	124.0 +/- 2%	28	29
MODULE LEVEL REPAIR ONLY			
32	128.5 +/- 2%	30	31.5
36	128.5 +/- 2%	30	31.5



SAFETY CIRCUIT TEST PROCEDURE

Equipment required:

a) Video Generator.

b) HV DC meter (0 to 40 KV, high Z).

c) External variable power supply (0V to 200 VDC @ 5Amps minimum).

d) 1 Giga ohm, 5%, 2W film resistor.

Before turning the TV on, connect the HV meter's negative probe (-) to ground (DAG ground recommended) and the positive probe (+) in the anode of the CRT. Connect a 1 Giga Ohm resistor in parallel with the HV meter. Then connect the external power supply's negative output (-) to chassis ground, that is, the negative lead of B+ filter capacitor, CX3420. Turn on the TV. Apply a video signal or tune the TV to a raster pattern. Adjust the G2 potentiometer for minimum, and set the brightness and contrast levels to minimum. Now adjust the output voltage of the external power supply to 124 VDC for CA25V/27V or 130 VDC for CA32V/36V. Then start increasing the voltage on the external power supply until the TV shuts down, and read the HV on the meter just before the voltage starts dropping.

***Note:** The external power supply may require a diode for blocking voltage from the chassis power supply to the external power supply. The diode should be connected between the positive output of the external power and B+ of the chassis. The cathode should be facing the B+ of the chassis. The recommended diode is Part No. 103-00339-04A (400 V of VRRM @ 3 Amps of average rectified forward current).*

Preface

This manual has been designed as a supplement to the CM-151 CA/CB training manual (923-3351TRM). It provides circuit descriptions as well as troubleshooting flowcharts for both CA and CB chassis. Each description includes schematic diagrams of the particular section(s) being discussed. These inclusions represent a change from some recent training manuals. Moreover, this manual is divided into two distinct sections, respectively, for CA and CB chassis. Such an arrangement should prevent confusion between the two.

Many servicers prefer to use their training manuals in conjunction with the corresponding service manuals. As such, the schematics contained in this training supplement were drawn to be fairly generic. However, as a concession to those who desire a quick reference, tables that include part numbers of major components have been supplied in each applicable circuit description. Note that these part numbers should only be applied to those sets which fall under component level repair warranty. (32" and 36" sets have a module replacement warranty.) Hence, when a table refers to "all models", it can only apply with certainty to all component level repairable modules. Likewise, in the troubleshooting section, flowcharts will often instruct the repair technician to replace a certain component under a particular situation. Again, such instruction concerns component level repair sets. Still, the flowcharts provide useful information for diagnosing a problem on component level warranty modules and replacement warranty modules alike.

Frequently, the tables refer the reader to the service manual for particular models associated with given parts, particularly with regard to the CA chassis. This is because at the time this manual was produced, there were 81 variants of the CA chassis in the field. In any case, parts referencing is really beyond the scope of a training manual. Furthermore, it is a good idea when looking up part numbers to refer to up-to-date service information. Generally speaking, training in circuit theory and operation does not change when part numbers do.

Finally, be sure to take special note of the safety information supplied in this manual. General safety information is provided for both chassis on the reverse side of the front cover. High voltage protection instruction for the CA chassis is located on the page following the general safety page and for the CB chassis at the start of the second section of this manual.

Table of Contents

Section 1

Section 2

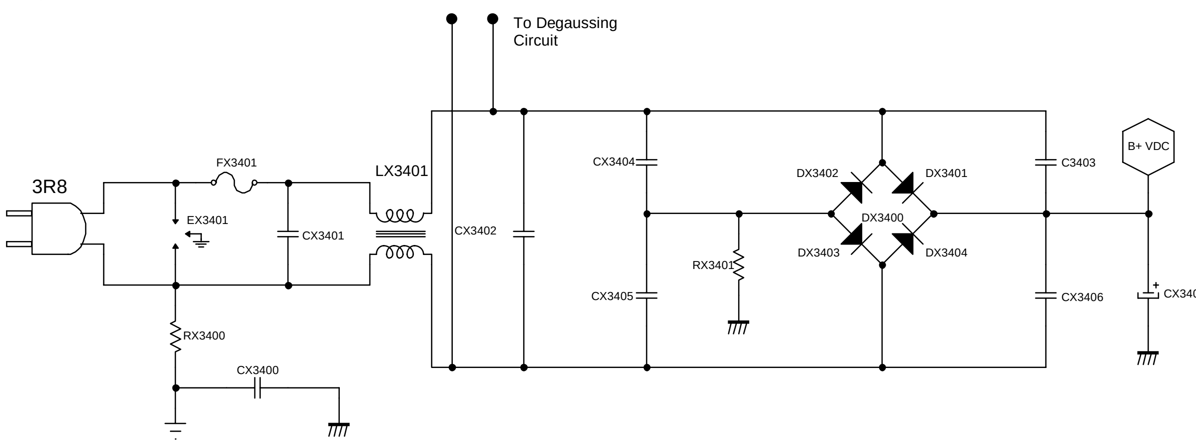
Introduction

The CA chassis is a cold ground chassis deriving its power from a switch-mode, flyback type, power supply. It features indirect B+ regulation, over-current protection (OCP), software controlled degaussing, necessities for Energy Star compliance, and provision for future universal power input (85VAC - 265VAC).

The switch-mode power supply, or SMPS, converts AC line power to the various DC voltages required by the receiver. Note that there is no switch to activate or deactivate the SMPS. It operates as soon as AC line power is present. Input power demands can reach a maximum of 130 watts on 25 and 27 inch sets and 145 and 150 watts on 32 and 36 inch sets respectively.

Switch-Mode Power Supply Primary Side

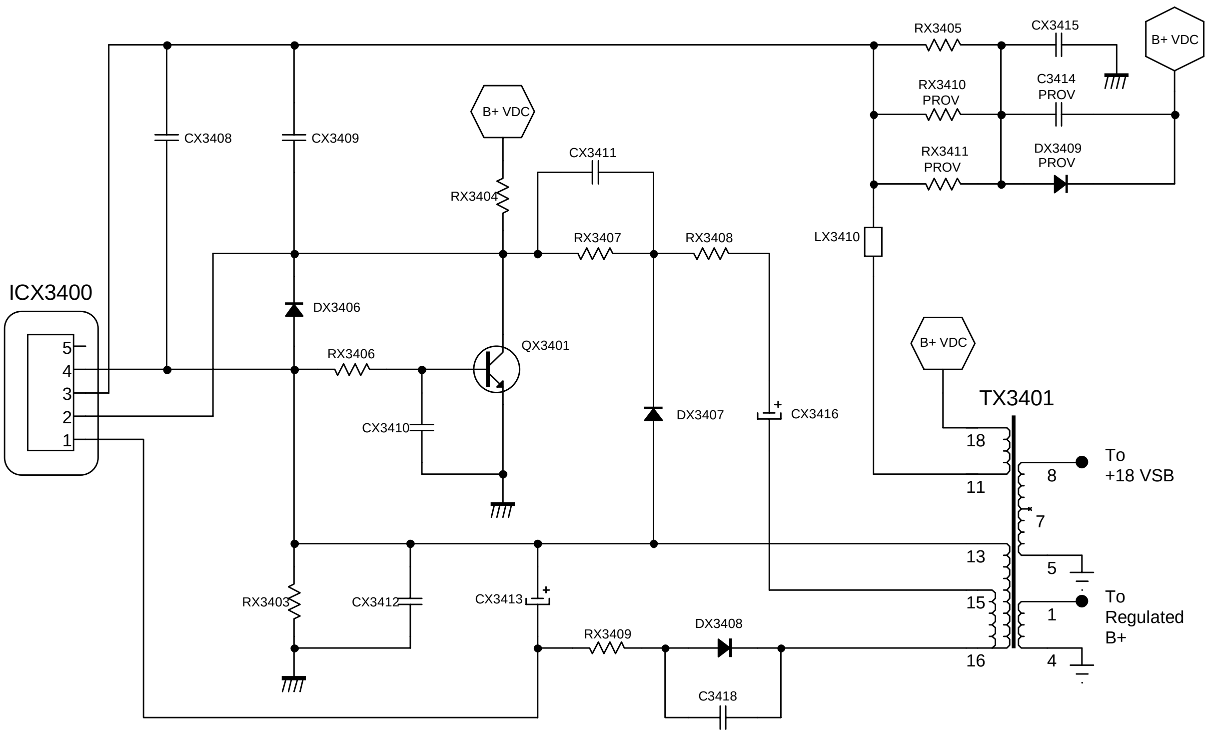
The receiver is protected from AC line surges by FX3401, a 4A, 250V fast-blow fuse. The AC operating range is between 90Vrms and 135Vrms. AC is first filtered by LX3401 and CX3402. It is then rectified using a diode bridge (package DX3400 on 32"/36", discrete components DX3401 through 3404 on 25"/27"). CX3407 smoothes out the resulting DC voltage. It is from this voltage (called VDC or raw B+) that the heart of the SMPS, the Switch-Mode Regulator, is run. Raw B+ can run anywhere from +127VDC to +191VDC.



<<Figure CA-1>>

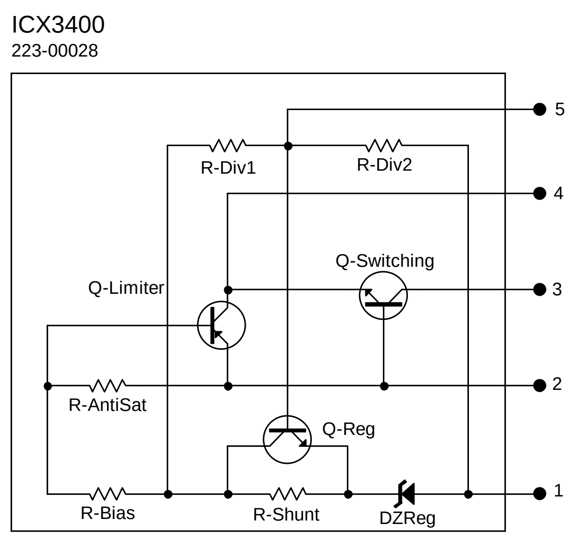
Primary components of the Switch-Mode Regulator circuit include the switching transistor, QX3401; the regulator IC, ICX3400; and the chopper transformer, TX3401. The actual chopper used will depend on the size of the set. This transformer isolates the rectifier and regulator sections, which use hot ground, from the rest of the CA chassis, which uses cold ground.

When line power is introduced to the set, raw B+ is supplied to pin 18 of the chopper (switch-mode transformer). At the same time a small amount of raw B+ is drawn through RX3404 into pin 2 of ICX3400. This voltage triggers the switching of a transistor internal to the regulator IC. Once this happens, current begins to alternate between flow and rest in the raw B+ winding (pins 18 and 11) of the switch-mode transformer. Alternation will occur at a frequency of approximately 25 KHz when the set is in stand-by, and near 50KHz when the set is powered up. Because of the transformer action, base drive to pin 2 of ICX3400 is from this time forward maintained by another winding on the chopper (pins 13 and 15) through CX3416.



<<Figure CA-2>>

Another winding from the chopper (pins 13 and 16) provides feedback to the regulation loop in ICX3400. The AC from this winding is half-wave rectified by DX3408 to supply a negative voltage to pin 1 of the regulator IC. ICX3400 is designed in such a way that it will adjust both its oscillating frequency and duty cycle to maintain -41 volts DC on pin 1. Thus as changing power demands are reflected in the chopper transformer, feedback to ICX3400 triggers a corresponding change in the regulated supply.



<<Figure CA-3>>

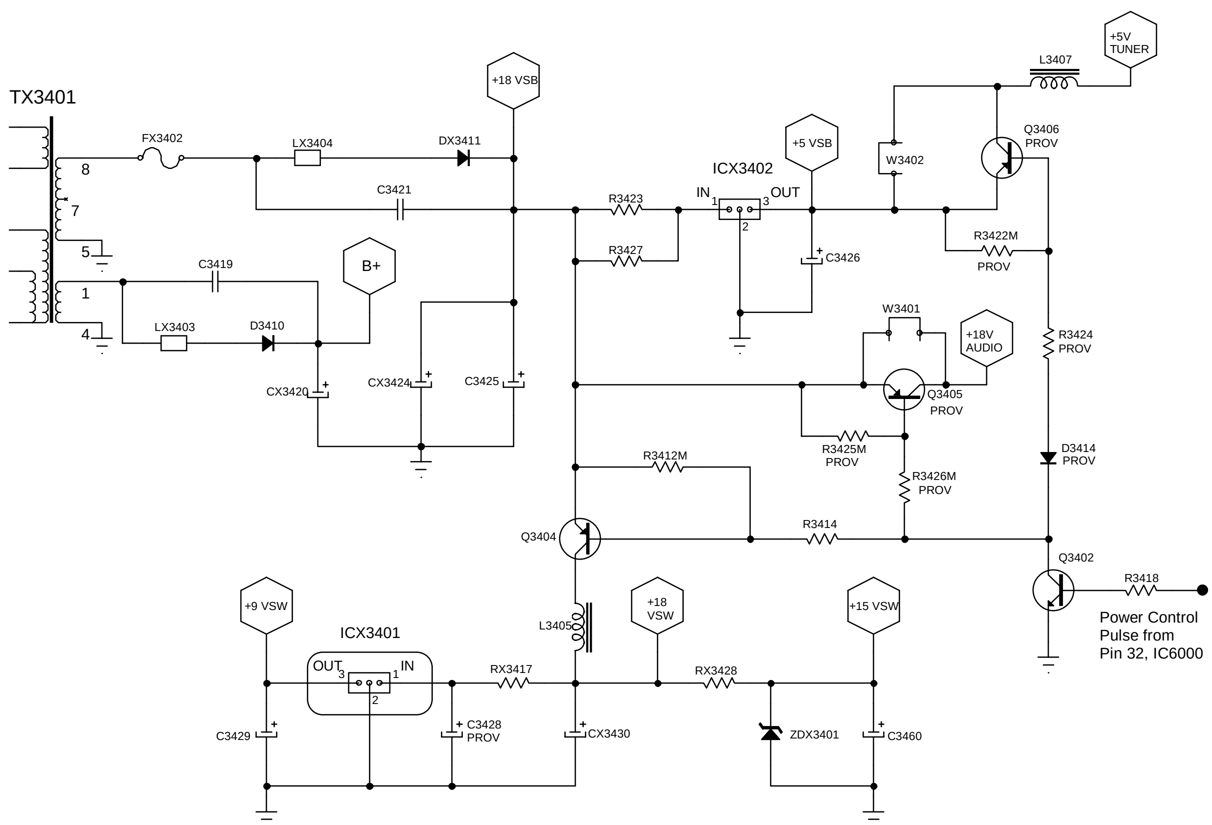
QX3401 serves as the Over-Current Protection (OCP) switch. If the current sensing resistor, RX3403, passes too much current to pin 4 of ICX3400 (the emitter of the internal switching transistor), the resulting

voltage at the base of QX3401 will switch that transistor on, shunting the regulator IC's base drive to ground. Such an action kills the regulator's oscillation, thereby eliminating power generation.

Several capacitors, CX3408, CX3409, CX3410, and CX3412, are used in the SMPS to reduce EMI (electro-magnetic interference). Additionally, RX3405 and CX3415 serve as a snubber circuit, to reduce peak voltage on the collector (pin 3) of ICX3400's switching transistor.

Switch-Mode Power Supply Secondary Side

The two windings on the secondary side of the chopper transformer generate the regulated B+ (or simply B+) which, depending on the size of the television, will be either +124 volts DC or +130 volts DC, and the +18 volts DC. Both are present when AC line voltage is supplied to the SMPS. Hence these voltages may be considered Stand-By (SB). The B+ supplies necessary power to the horizontal sweep and the horizontal output sections. It is filtered and rectified using LX3403, C3419, and D3410, and it can be measured across CX3420. Note that the B+ line does not have a fuse. The OCP circuit mentioned above serves to shutdown the power supply if too much current is drawn through the regulated B+ circuit.



<<*Figure CA-4*>>

On the other hand, the +18 volts DC (or +18 VSB) is fused by FX3402. Rectification and filtering of the +18 VSB is accomplished by an arrangement similar to that of the B+. The resulting +18 volts DC may be measured across CX3424. This voltage is further broken down to provide power to various circuits described below.

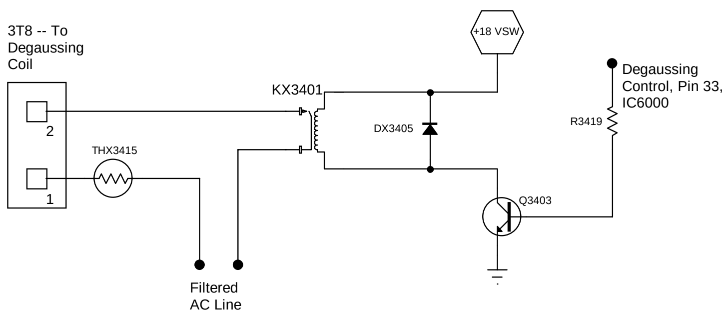
CA CIRCUIT DESCRIPTIONS

ICX3402 regulates from the +18 VSB to provide +5 VSB. The +5 VSB powers the microprocessor, IC6000, and the tuner, TU6000. Additionally, part of the power from the +18 VSB supplies +18 volts to the audio circuitry (+18 AUD). The remainder of the +18VSB power is used when the set is powered up. This powered up voltage is typically referred to as a switched voltage (VSW). The +18 VSW powers the horizontal drive amplifier. That same +18 VSW is also regulated through ICX3401 to produce a +9 VSW. This +9 volts powers the video signal processor, ICX2200, and, in stereo sets, IC1400. Finally, a +15 VSW is generated from the +18 VSW using RX3428, ZDX3401, and C3460. The +15 volt supply powers the ABL video and the variable audio output circuits.

These switched voltages turn on given a DC level from pin 32 of IC6000. This signal will of course come on when triggered by the power on key from the keyboard or the IR detector, IR6000. The DC level at pin 32 should be near +4.8 volts DC. This will drop across R3418 and switch the base of Q3402. As this transistor turns on, it drives Q3404 into saturation and activates the switched voltages.

Degaussing Control

Degaussing is accomplished via software in the CA chassis. At turn on, pin 33 of IC6000 generates a +4.8 volt DC level. After dropping through R3419, this DC switches on Q3403 to allow current flow through the degaussing relay, KX3401. With the relay now turned on, filtered AC line current travels into the degaussing coil passing through the thermistor, THX3415. 760 milliseconds after power-up, the microprocessor sets the voltage to zero, and the relay opens cutting off AC to the coil.



<<Figure CA-5>>

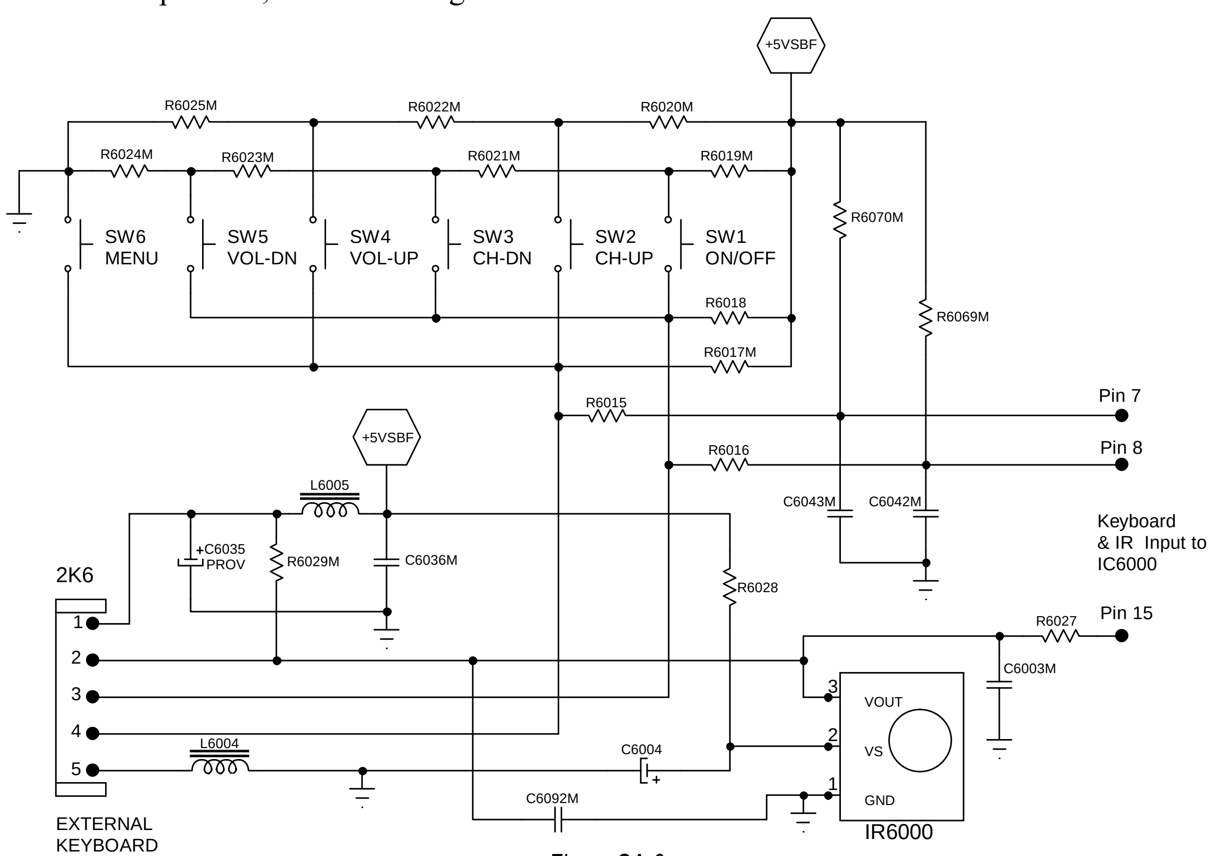
Introduction

The CA chassis employs IC6000 as its microcontroller. All end user and servicer controls are accessed using this IC. While most of its functions will be described in terms of how they are used by other devices in the receiver, a number of facts concerning the microprocessor and its input devices will now be presented.

The microprocessor's job is to communicate control instructions and feedback information to and from various other processors and input devices in the set. These include the video, audio, PiP, audio & video switch ICs, the tuner, the EEPROM, the keyboard and IR detector, and the reset IC. Some of these use a direct connection via either switch, variable pulse, or DC level for communication. Others rely on the I^2C bus, also known as serial clock and data bus. IC6000 provides 2 sets of clock and data lines. The first set is pins 37 and 39, and the second is on pins 36 and 38. The EEPROM and the factory setup connector, 4G9, are the only devices which receive clock and data pulses from the first set.

Input Devices

The IR detector demodulates pulses from the 40 kHz modulated carrier and sends the pulses to pin 15 of the microprocessor. There a special algorithm interprets the pulses as the various commands they represent. The keyboard is only slightly more complicated in its operation external to IC6000. It works by varying voltage on only two input pins (7 and 8) using resistor networks. A/D converters inside the micro interpret the different voltages. Because voltage detection is used rather than active keyboard scanning, keyboard radiation is not a problem, but maintaining a +5VSB to within ±4% is critical.



<<Figure CA-6>>

CA CIRCUIT DESCRIPTIONS

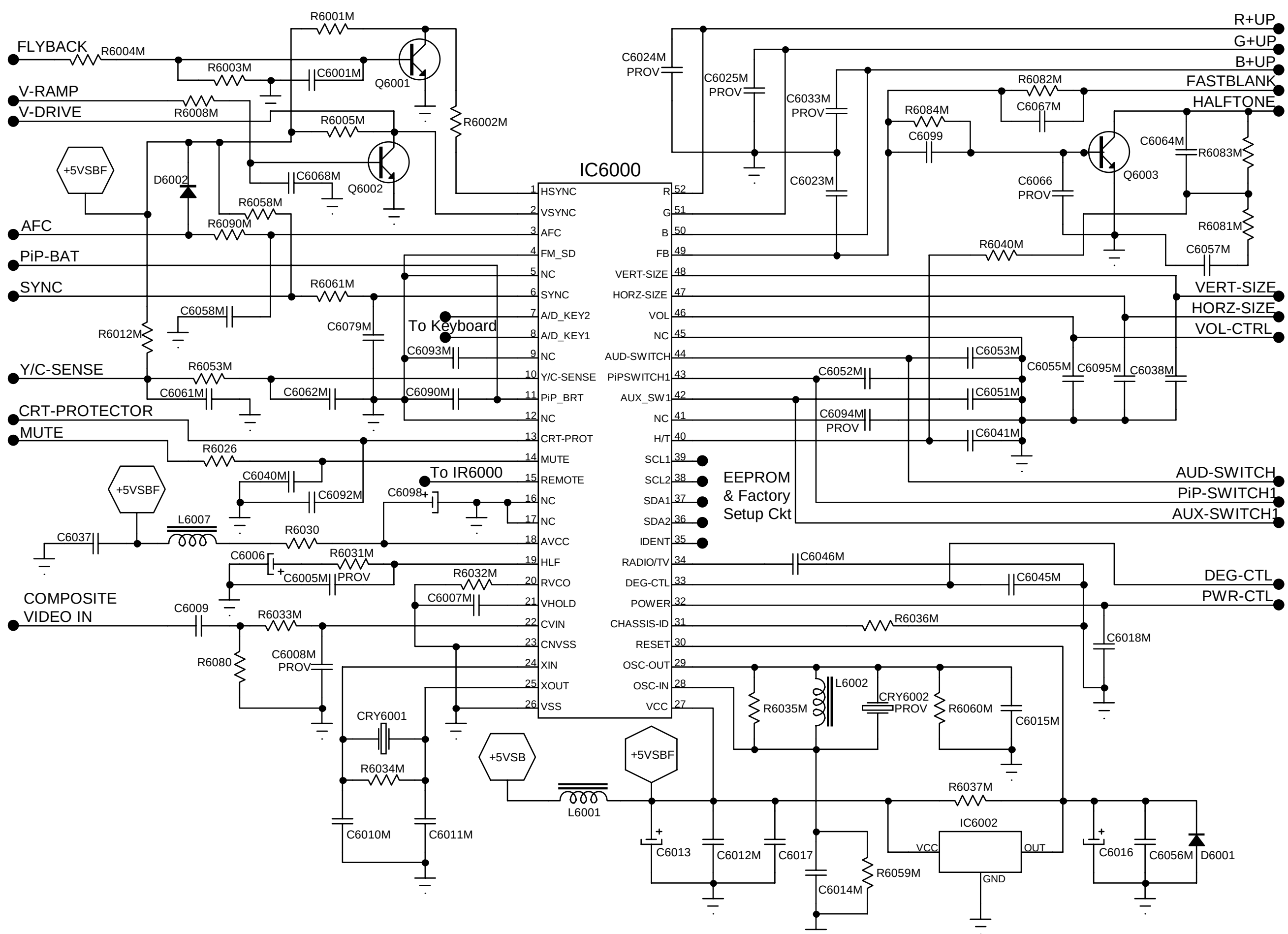
For those CA chassis that have the keyboard and IR detector built onto the module, the schematics are included. Keep in mind, however, that many of the various CA chassis have a keyboard and IR module that is separate from the main board.

Microcontroller

VCC is provided to pin 27 of the microprocessor from the +5VSBF supply. While this voltage is relatively low, IC6000 is fairly demanding in terms of current. This same voltage also powers the keyboard and IR detector. Additionally, the +5VSBF is used as analog VCC and enters the micro at pin 18.

IC6002 serves as a reset IC for the main microprocessor. Note that it comes in a transistor type package. It accurately resets the micro when SB voltage is detected. Pin 30 is the reset signal input for IC6000. The micro enters reset state after detecting a low on pin 30 of 2µS or more.

When the micro receives a power on signal from either the keyboard or the remote, the degaussing control pin 33 turns on the degaussing circuit for 760ms. At the same time a constant voltage level from pin 32 turns on the switched voltages in the power supply.



<<Figure CA-6>>

Horizontal and vertical synchronization pulses are fed into pins 1 and 2. These provide the microprocessor the current sweep location of the beam, which is necessary to correctly interrupt main video for various

types of on-screen display (OSD). Neither sync pulses come directly from the video processor where they are first produced. Horizontal sync is actually fed back from the sweep transformer on the flyback pulse line. Vertical ramp signals feed the base of Q6002. Sync is produced on the collector and fed to the vertical amplifier and through R6006M to the V-Sync pin of the micro. OSD or CC (closed captions) are sent as processed RGB (red, green, & blue) from pins 50, 51, and 52. At those times it is necessary to blank out main video, a fast-blank (FB) pulse is sent to the video processor from pin 49 along with the processed RGB. An exception to this occurs when PiP is displayed. Under that circumstance, the fast-blanking pulse without RGB is sent to the video processor.

Some CA chassis feature a halftone function that dims video surrounding OSD. This halftone circuit is described in the video section, but is controlled by a DC level from pin 40.

Closed captioning display is accomplished in the microprocessor by use of the composite video into pin 22. Here a data slicer extracts the caption information and outputs it to the RGB pins when captioning is requested by the user. Note that when OSD needs to be on the screen, such as after a channel change or during a volume change, the OSD will have priority, and CC will mute. IC6000 also gains synchrony information from the composite video stream.

Pin 6 is a signal detection pin. When the tuner sends a bona-fide signal to the video processor, it separates the horizontal sync signal from the IF and sends it to this portion of the microprocessor. It can then be used to determine if a certain channel is carrying an active broadcast.

Automatic frequency correction (AFC) is sent to the microprocessor via pin 3. The DC level on pin 3 tells the microprocessor if it needs to communicate an adjustment to the tuner to allow for clearer channel reception. The ideal voltage level here should be approximately +2.5 volts.

IC6000 provides CRT-protection for the set through pin 13. Operation of this shutdown depends on a DC level from the CRT protection circuit off the vertical amplifier circuit. Should the vertical IC2100 fail, the DC level will no longer be present. In this situation, the CRT-protection latch will shut the receiver down three seconds after detecting the failure. This circuit will prevent the CRT from burning a horizontal phosphor line in the center of the screen or, worse yet, cutting the yoke end of the tube off completely.

The remainder of the input and output pins of IC6000 are adequately described in other sections of this manual. Refer to the video, audio, and deflection sections of the CA chassis for these descriptions.

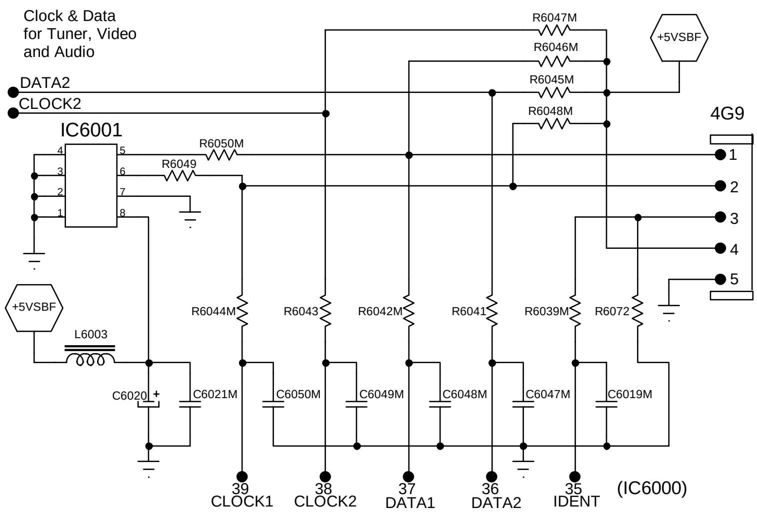
IC Location	Part #	Notes
IC6000	221-01384-01	
	221-01384-02	Refer to Service Manual
	221-01386-01	for Corresponding Model
	221-01387-01	
IC6001	221-00745-04	All Models
IC6002	221-01177A	All Models

<<Table CA-1>>

CA CIRCUIT DESCRIPTIONS

Memory

The EEPROM, IC6001, is a small but vital part of the CA receiver. This 512 byte memory chip is responsible for storing servicer adjustments, channel information, and user settings, even when power is removed from the set. This information is transferred on the clock and data lines from the micro into pins 5 and 6. The EEPROM is powered by the +5VSBF source at pin 8.



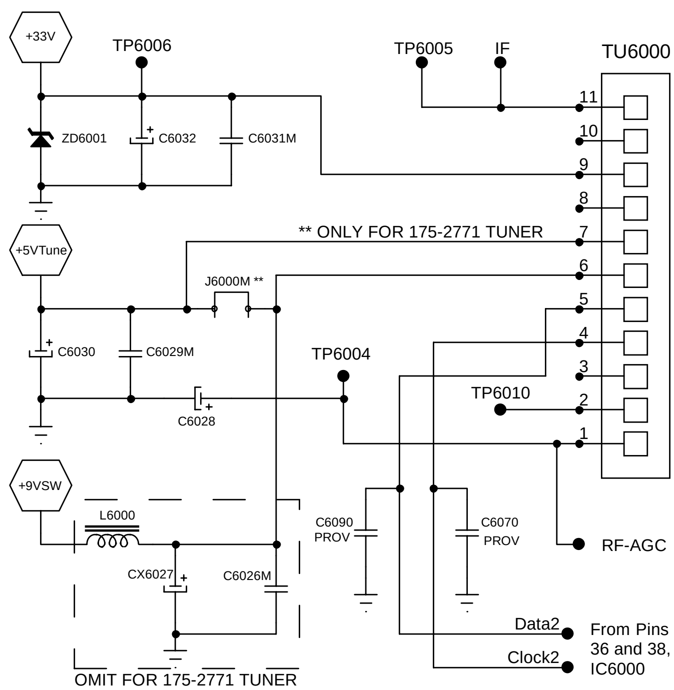
<<Figure CA-7>>

Tuner

Cable or off-air signals are received into the television by way of the antenna jack of the tuner, TU6000. The input and output impedance of this device is 75 ohms. It provides for 181 channels (including cable). It uses +33V for tuning, +5VTune as tuner B+, +4.3V for AGC, and on some chassis +9VSW.

As with standard varactor tuners, varying voltage across an internal varactor results in a different internal resonant frequency, whereby tuning of the various channels is achieved. Control of this process is accomplished through the I^2C (serial clock and data) lines attached to pins 4 and 5 of TU6000. These transfer control data to and from IC6000.

AGC (automatic gain control) voltage is applied to pin 1 of the tuner from pin 3 of ICX2200. This DC voltage varies in response to signal strength from the tuner so as to avoid signal distortion not only from low signal levels, but also from signals strong enough to otherwise cause clipping distortion. AGC voltage will alter the signal level accordingly.

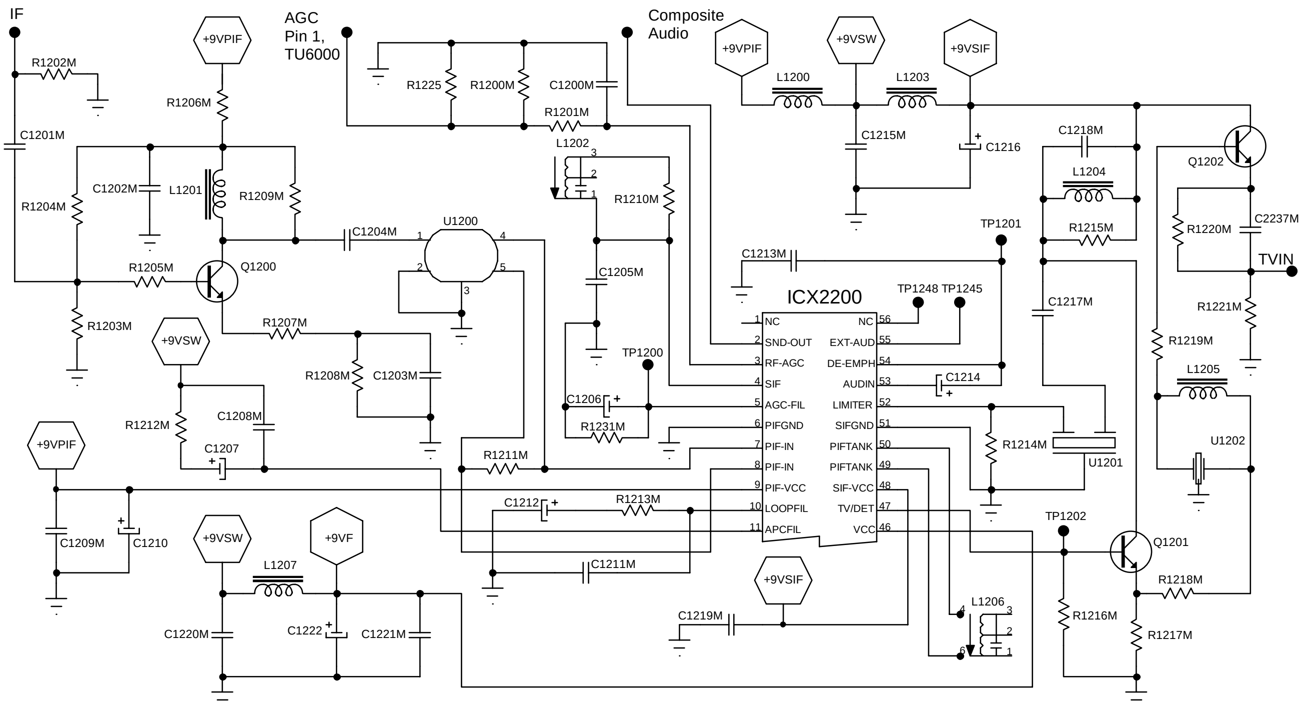


<<Figure CA-8>>

IF Processor

Tuner IF (intermediate frequency) comes from pin 11 of the tuner. This is filtered and amplified (see Q1200, U1200, and surrounding circuitry) before it is fed into pins 7 and 8 of ICX2200, the IF/video processor (sometimes called the Jungle chip). IF consists of PIF (Picture IF), SIF (Sound IF), and CIF (Chroma IF).

CA CIRCUIT DESCRIPTIONS



<<Figure CA-9>>

ICX2200 powers its IF section using +9VPIF (pin 9) and +9VSIF (pin 48). The IC's main VCC is a +9VF supply to pin 46. IF signal continues from pin 47 at nearly 2Vp-p to an FM trap where SIF is separated from PIF. SIF reenters ICX2200 at pin 52, the limiter. From this, composite audio is developed and transmitted from pin 2 of the video processor to the audio circuitry. The remaining PIF passes through Q1202 for de-amplification to 1Vp-p. The resulting signal, denoted TVIN, is passed to both the Jungle IC at pin 37 and pin 5 of IC2902 (refer to the jack-pack and switching section below).

AFT (automatic fine tuning) is also derived from the video processor at pin 44. This signal feeds the microprocessor, IC6000, to generate minute tuning adjustments so as to maintain optimum channel quality.

Part Location	Part #	Notes
TU6000	175-02721	Refer to Service Manual
	175-02771	for Corresponding Models
ICX2200	221-01165	All Models

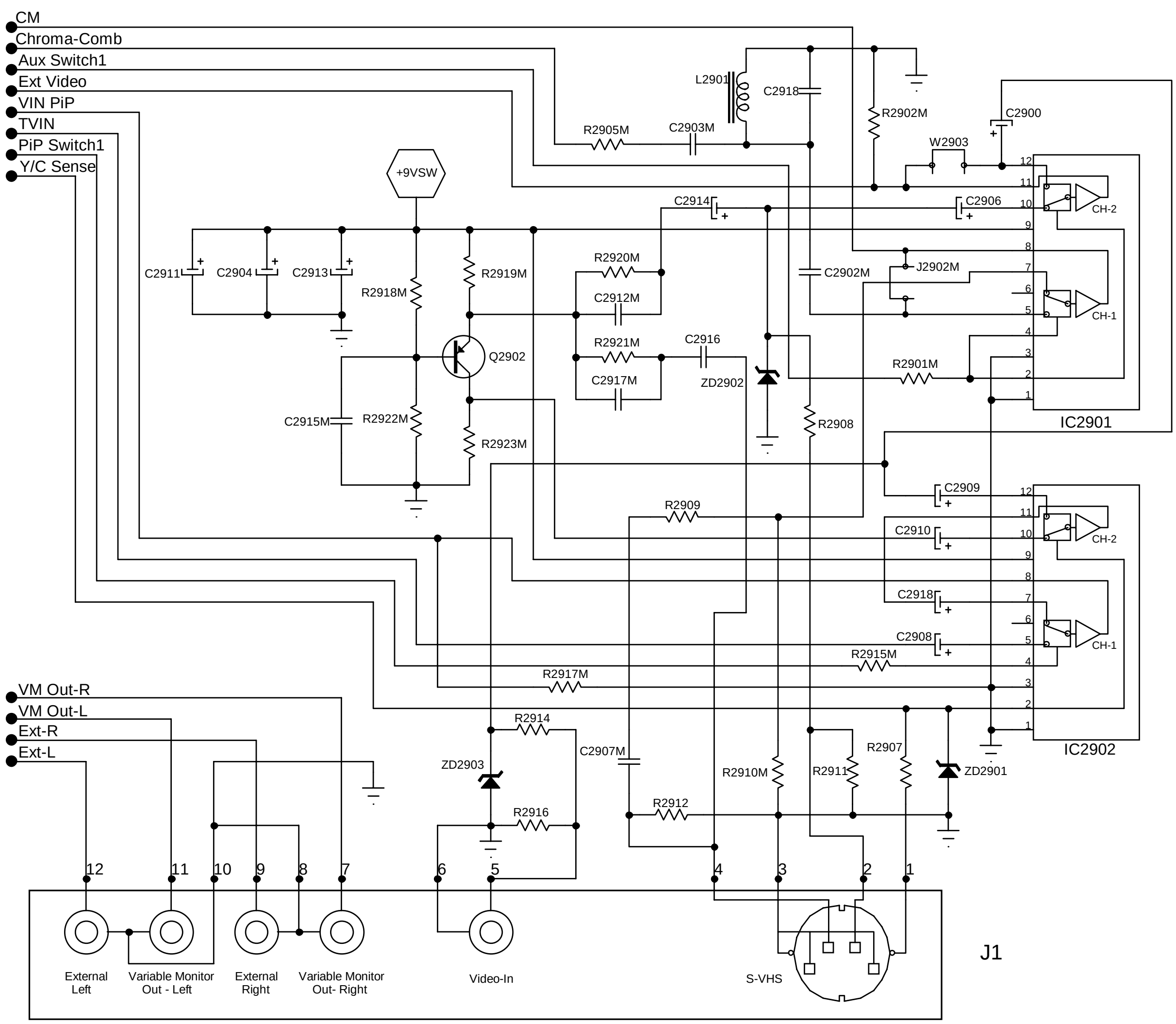
<<Table CA-2>>

Introduction

ICX2200 has numerous duties involved in television image and sound production. As mentioned above, it processes sound and video IF. Additionally, it prepares NTSC video utilizing separated chroma, luma, and OSD from IC6000. Accounting for controlled preference information from the micro such as brightness, tint, sharpness, contrast, etc... the "Jungle" chip then produces this video signal as RGB which is amplified and sent to the picture tube. Finally, the video processor generates the very drive signals that cause the deflection circuitry to operate and produce high voltage as well as picture.

A/V Switching

At this point, because of its interaction with the video processor, an explanation of the jack-pack switching section is expedient. Depending on the extra features a CA receiver has (S-VHS Video or Y/C, PiP), the chassis will have two switching ICs, IC2901 and IC2902. IC2902 is the PiP switching IC. The first



<<Figure CA-10>>

switching channel of this IC switches the PiP between external and internal video sources based on the PiP Switch1 signal (pin 4, IC2902) from the microprocessor. The internal video signal, denoted TVIN, is the same signal as the one entering pin 37 of ICX2200. Whichever signal is selected is sent as VIN PiP to the PiP module through pin 10 of the PIPA1 connector. The second switching channel of IC2902 allows selection between composite video input and S-Video input. While normally it defaults to composite video, its switching action is based on the presence of S-Video. The output of this switch feeds the external side of the PiP switch.

IC2901 is referred to as the main switching IC. Both switching channels of IC2901 are controlled by the AuxSwitch1 input from the microprocessor. It is tempting at first glance to assume that this IC switches between external and internal video sources. However, ICX2200 actually handles that process internally. Rather, IC2901 switches the between the external source to be viewed (composite or S-Video) on switching channel 2. The output from this channel goes to pin 39 of ICX2200, the external video input. Channel 1 switches between the internally separated chroma signal and the S-Video chroma signal, and feed its output back to pin 45. See below for a further description of video separation.

Video Development

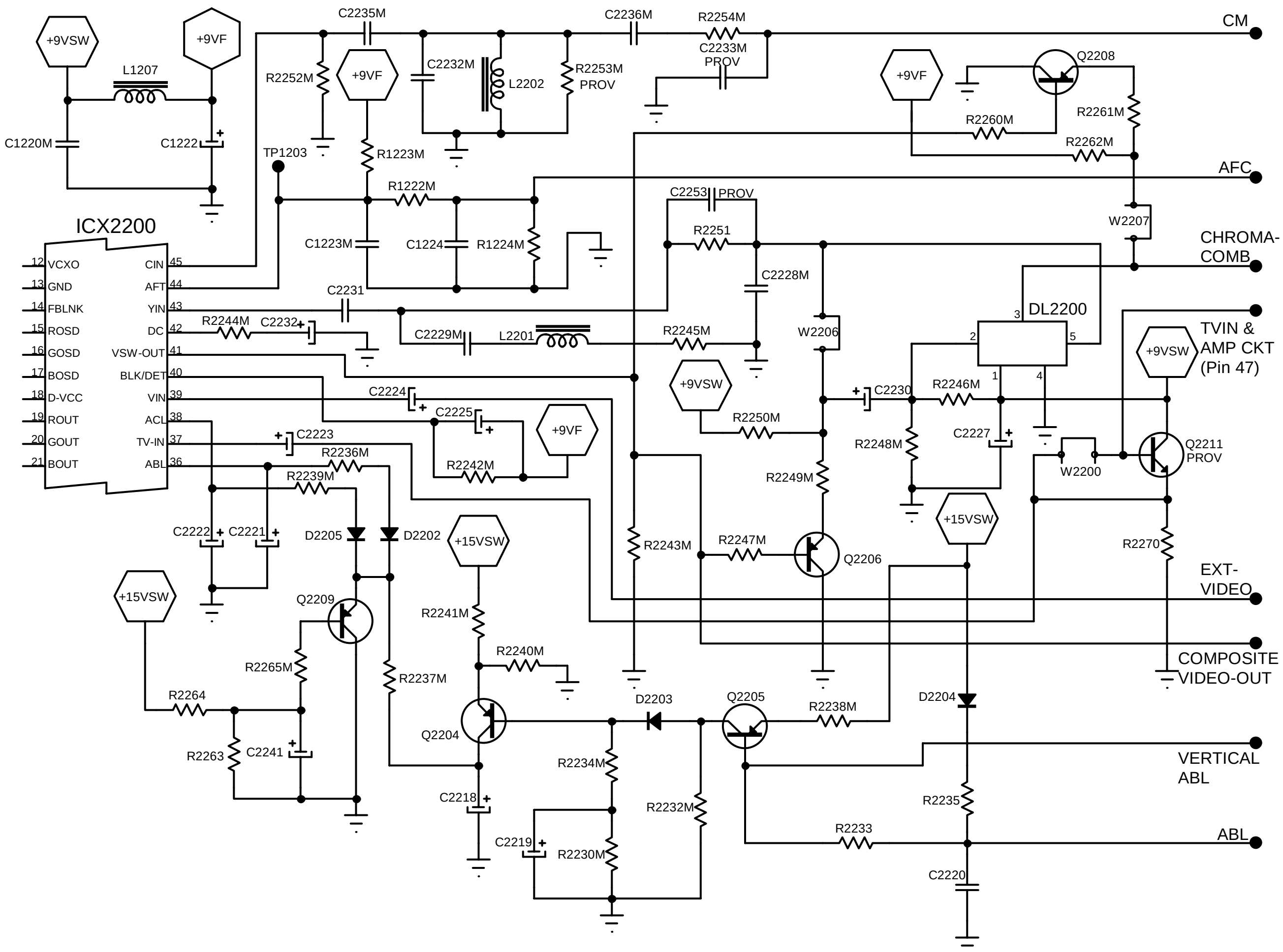
For video processing, ICX2200 will switch between tuner IF, which as discussed above enters the IC at pin 37, or an external video source, which enters the Jungle chip at pin 39. Switching between these will be directed by the microprocessor via the I^2C bus entering ICX2200 on pins 27 and 28. The selected signal is emitted from the switched video out pin (41) as composite video. This signal is sent to the microprocessor and the glass comb-filter, DL2200.

The purpose of the comb-filter is to separate chroma from luma. Its superiority to conventional filtering and separation schemes is that it reduces cross talk between chroma and high-frequency luma. Historically, sets without this feature were prone to have rainbow effects on objects whose luminance frequency approached the 3.58 MHz color subcarrier. (Note that this frequency is established by CR2201, the color crystal in CA chassis.) The result of the comb-filter's operation is that cross color distortion is minimized for much more highly detailed objects.

Composite video enters the comb-filter on pin 2. Luma is produced on pin 5 and is fed to pin 43. A 3.58MHz trap (C2229M, L2201, & R2245M) removes any residue chroma. Separated chroma exits the comb-filter at pin 3. In sets that utilize IC2901 for jack-pack switching purposes, chroma from the comb-filter is sent to pin 5 and exits at pin 8. This signal is then denoted by CM, and is passed back to the video processor via pin 45. (In sets that do not use IC2901, chroma passes directly to pin 45.) A band-pass filter (C2232M, R2253M, & L2202) eliminates any remaining luma.

Once inside the Jungle IC, luma is processed with numerous factors including contrast and brightness. Brightness and contrast information from the beam current passes into pins 36 and 38 from the circuitry consisting of Q2204, 2205, and 2209. ICX2200 responds to this information by limiting (when necessary) contrast and brightness to the RGB outputs. Basically, the ABL responds to current from pin 8 of the sweep transformer, TX3204. D2204, R2235, and C2220 make this signal positive. It is then inverted by Q2205 and smoothed as it passes to Q2204. As beam current approaches 1.5 mA (1.3 mA on 25", 0.9 mA on 19"/20") Q2209 starts to turn on and shunts excess current to ground. In addition to controlling the

RGB output, this circuit helps to prevent blooming. Excessive current draw in the picture tube will lower voltage and hence decrease beam acceleration. This results in an increase of the sweep. Without ABL, the blooming effect is usually seen when very bright images appear on the screen. ABL should prevent this and extend the life of the picture tube.



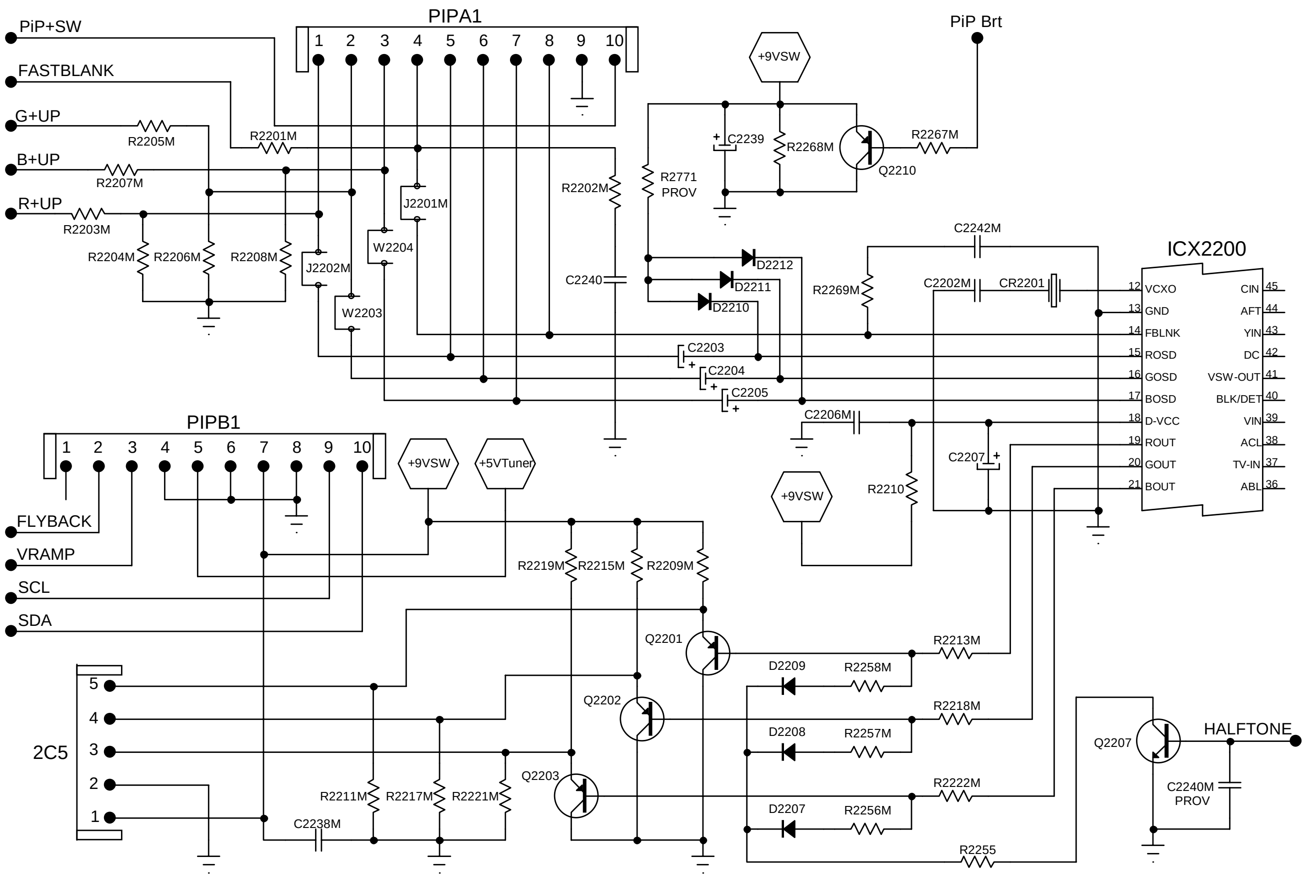
<<*Figure CA-11*>>

Before sending processed RGB (red, green, & blue) outputs to the picture tube, ICX2200 integrates any OSD (on-screen display), CC (closed caption), and PiP (picture in picture) into the video. At a particular point in the television's scan across the picture tube, where the video is to display an OSD object, a fast-blanking (FB) pulse is sent from the microprocessor to the video processor at pin 14. This pulse of course blanks the main screen video so that OSD can have precedence. Simultaneously, processed RGB from the microprocessor enters the Jungle chip at pins 15, 16, & 17. This video fills in the blanked portion to be put onto the main screen.

Picture-in-Picture

A few notes concerning PiP are noteworthy here. First those sets that have PiP will not be able to produce video without the PiP module installed unless the PiP section is jumpered out. J2201M, J2202M, W2203, and W2204 accomplish this. PiP signal enters the PiP module at pin 10 of connector PIPA1. This signal is converted into RGB by the PiP processor and sent on to RGB OSD inputs of ICX2200. Pins 2 and 3 of

the PIPB1 connector provide sync to the PiP processor. Pins 9 and 10 of the same connector allow I²C bus communication between the PiP board and the microprocessor. PiP brightness however is controlled from pin 11 of the microprocessor. This controls the bias of Q2210, which varies a DC level on the OSD input lines to ICX2200.



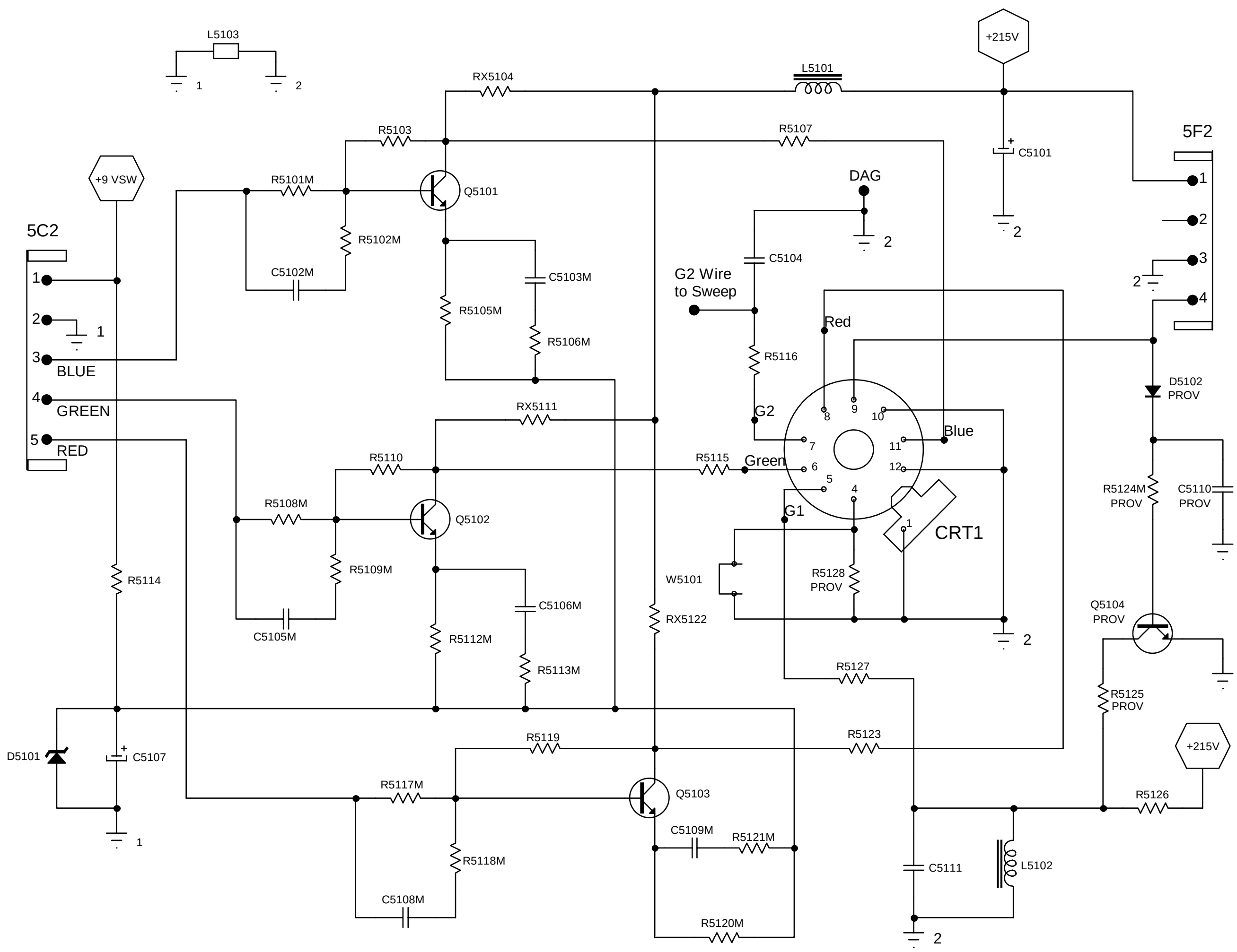
<<Figure CA-12>>

After PiP or OSD RGB enters the Jungle IC, it is combined with processed luma and chroma and then exits ICX2200 as main video for the picture tube. Red, Green, and Blue outputs are found on pins 19, 20, and 21. Some CA receivers have a halftone circuit that taps off these lines. When Q2207 is switched on by a signal from the microprocessor, a limited amount of RGB signal is shunted to ground. The on-screen effect of this is a slightly dimmed video. This halftone signal is output in such a way to appear as a darkened but transparent window surrounding the OSD.

Video Amplification

Before being fed into the CRT socket board via connector 2C5, RGB is pre-driven by Q2201, Q2202, and Q2203. The resulting signals are then sent to the main color driver transistors, Q5101, Q5102, and Q5103. These transistors have a high 300V collector to emitter breakdown voltage and a low collector to base feedback capacitance (less than 3pF). Additionally, the series-parallel arrangement of both their emitter and base circuits involving both capacitors and resistors allow for improved high and low frequency response. The cutoff frequency of these drivers is 70 MHz. R5103, 5110, and 5119 from base to collector help to increase bandwidth response of the drivers. These provide negative feedback from the output and decrease gain. As gain decreases however, bandwidth response increases. The driver transistors are

powered by the +215V source derived from the sweep transformer, but the actual DC voltage at the collectors will be lower (+130 volts is a good ballpark figure) because of the resistors RX5104, 5111, and 5122 and variations in the drive signal.



<<Figure CA-13>>

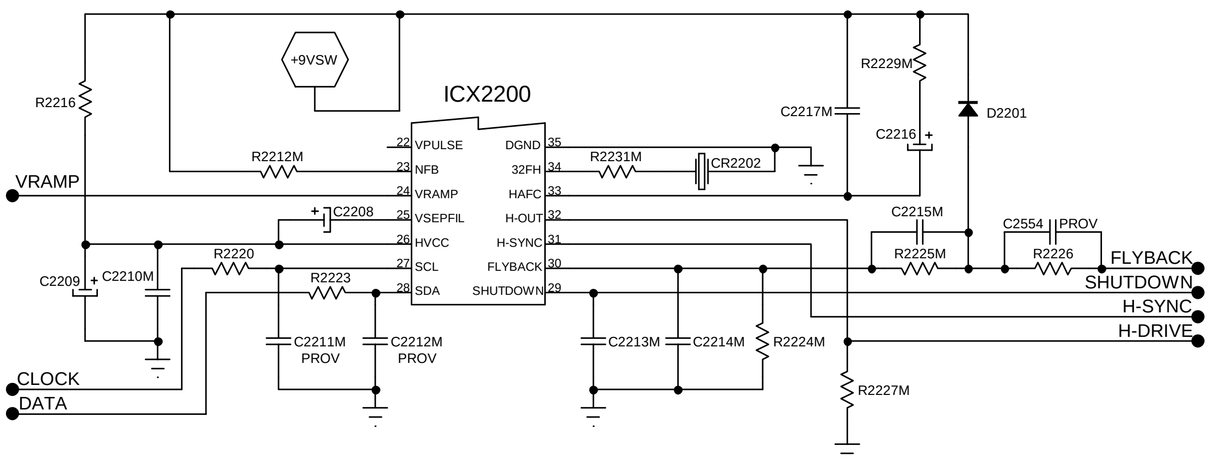
The emitter circuits of each driver are attached not to ground, but to a reference voltage of about +3V. This reference voltage is established by R5114 and D5101 and serves to set a black level for the cathodes around +165 volts. The reference voltage must be relatively noiseless, so C5107 is used to eliminate any interference.

A number of the CA chassis provide an afterglow cutoff circuit on the CRT socket board. This circuit makes use of the fact that with respect to the picture tube, G1 is the ground. Because C5107 takes a relatively long time to discharge, there is the possibility that the picture tube could continue producing electronic emissions for a short time after the receiver is turned off. The afterglow cutoff makes use of power from the filament voltage (pin 4, connector 5F2). When the receiver turns off, the loss of this voltage turns off Q5104. This allows for a brief moment the G1 cathode to become more positive, leaving less potential on the other cathodes from any remaining voltage across C5107. C5110 determines the dead time on response, and C5111 determines the rise time of the G1 voltage, both of which are between 10 and 30 milliseconds.

CA CIRCUIT DESCRIPTIONS

Deflection Processing

The last portion of the video processor to be discussed is the deflection section. This is the part of the IC from which the vertical and horizontal deflection signals are derived. A critical power supply to this section is the +9VSW which feeds pin 26. Pin 24 emits the V-Ramp signal, from which both vertical sync for the microprocessor and vertical drive for the vertical amplifier are developed. Refer to Q6002 in the microprocessor circuit for this process. Horizontal drive comes from pin 32. This ultimately drives the horizontal output transistor, which provides both horizontal deflection and power for the sweep transformer. Pin 31 provides the sync pulse output to IC6000. This signal is really the horizontal sync pulse separated from the rest of the video signal. It allows the microprocessor to determine whether or not the receiver has a valid signal. The flyback pulse is input to pin 30, thus allowing sweep feedback to the video processor's deflection section.



<<Figure CA-14>>

High-Voltage Protection

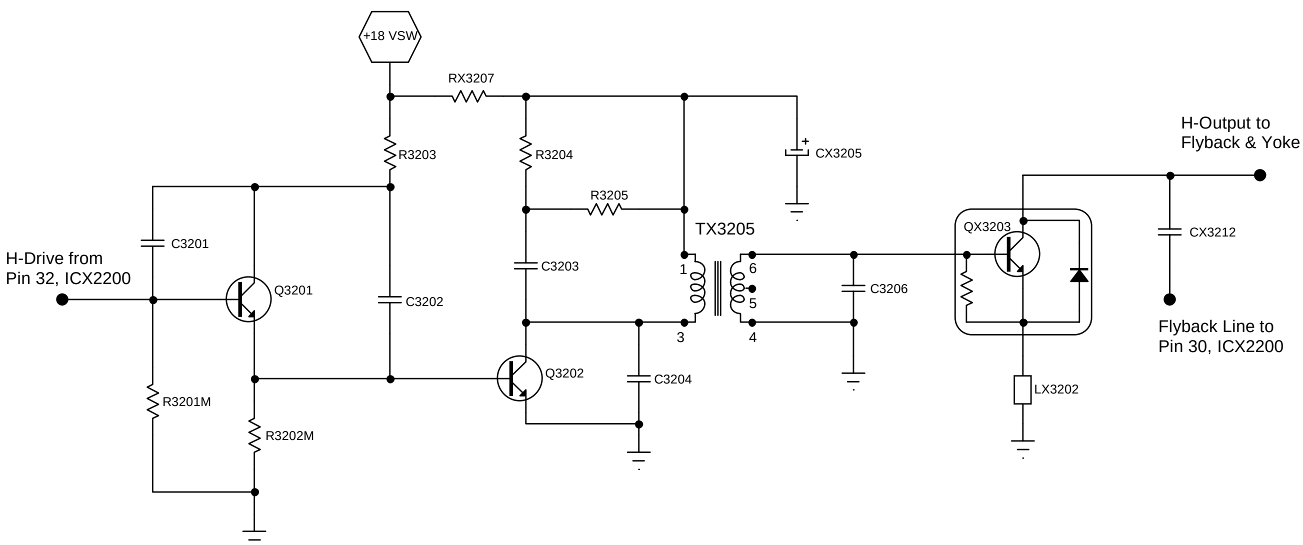
The last terminal of note here is pin 29, the x-ray protection/shutdown pin. If the potential at this pin rises above +3.5 volts DC, the video processor will automatically clamp the horizontal output signal, shutting down the receiver. In the event that this occurs, the microprocessor will have to be reset before the television can be powered up again. Voltage at pin 29 is based on the voltage output from the flyback. High voltage shutdown will correspond with an over-voltage in the picture tube, which could otherwise begin to emit x-radiation.

Introduction

After deflection control signals are produced by ICX2200, they need to be modified and amplified before they are output to the deflection yoke. The CA chassis accomplishes this necessity for 25” to 36” television sets through the sweep transformer and the surrounding horizontal and vertical deflection circuitry.

Horizontal Drive

The Horizontal Drive (H-Drive) circuitry exists to control the drive signal to the Horizontal Output Transistor (HOT) as well as provide deflection to the horizontal yoke. Typically H-Drive operates at 15.734 kHz. As it passes through the driver circuit, H-Drive signal is amplified to provide a sufficient signal to the HOT without causing it to go into saturation, thereby preventing distortion of the drive signal. H-Drive is produced at pin 32 of the Video processor (ICX2200) and is passed to the drive circuit through R2227M, a surface mounted resistor. The signal enters the base of Q3201 which is directly coupled through its emitter to Q3202. Finally, the signal passes from the collector of Q3202 to the Horizontal Driver Transformer, TX3205, where voltage-to-current conversion and proper waveshaping occurs.



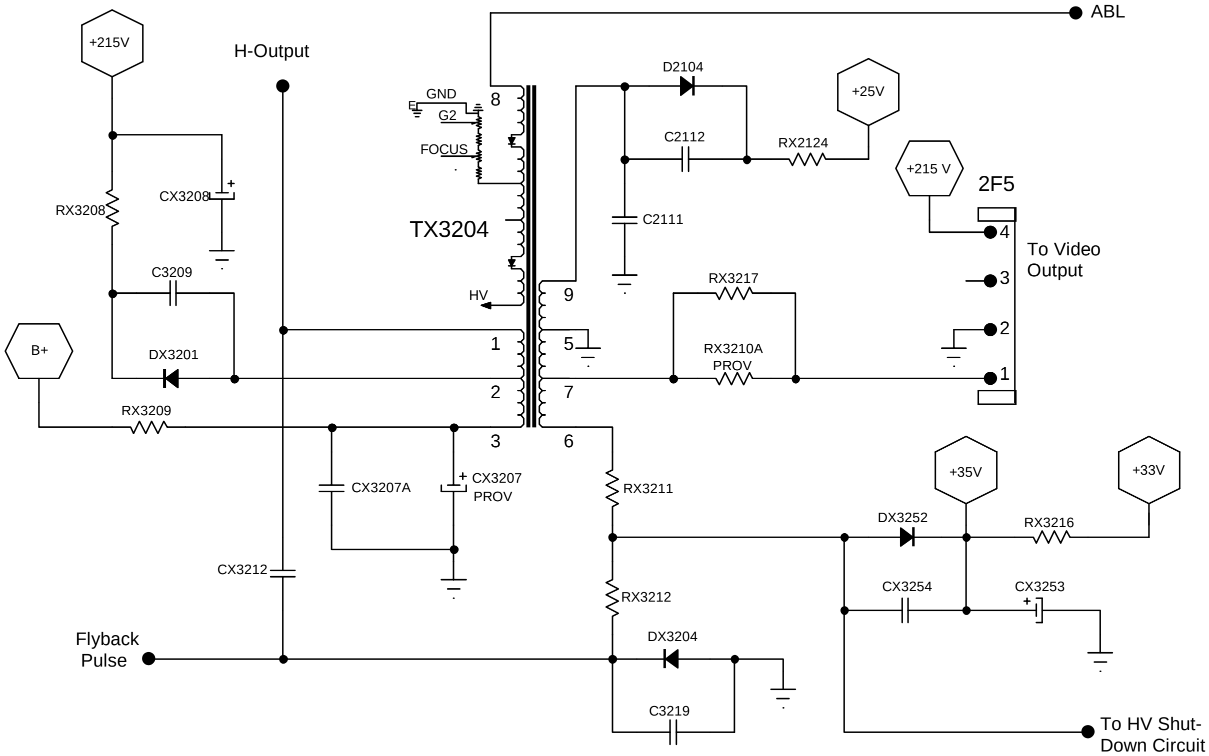
<<Figure CA-15>>

Flyback Transformer

From here, the signal switches the HOT (QX3203) on to provide a current shunt for the sweep transformer, TX3204 and the horizontal yoke. This switching alternately passes then blocks the B+ voltage provided through the primary winding of TX3204 to the collector of the HOT. The changing magnetic field in the sweep transformer caused by this action generates the high voltage (HV). This high voltage should normally be between 26 and 30 kV. The particular value will correspond to the size of picture tube in the set. G2 (screen control) and Focus voltages are tapped from a portion of the same winding that HV is derived from. As usual G2 and Focus may be adjusted by pots on the sweep transformer. These run to the CRT socket board.

CA CIRCUIT DESCRIPTIONS

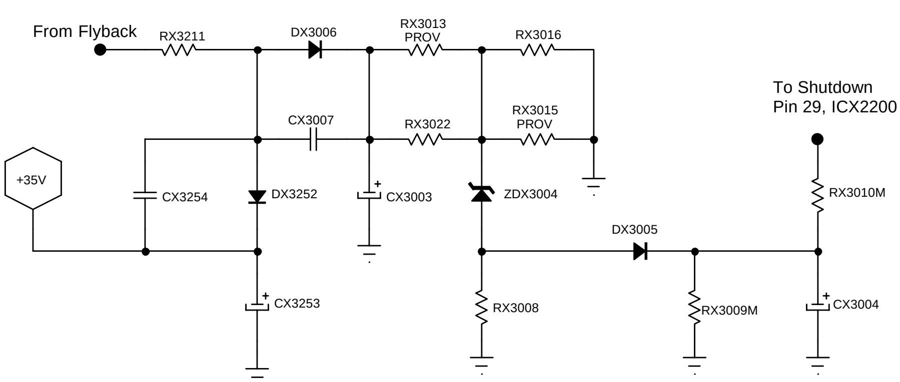
A number of secondary voltages are also provided by the sweep transformer's action. Particularly, +215 volts is supplied from pin 2 to the Video Output circuitry for driving color. In addition, +35V and +25V are supplied, respectively from pins 6 and 9, for horizontal width and pincushion control circuitry (when necessary) and for vertical amplification circuitry. Filament voltage is also supplied from pin 7 into pin 1 of connector 2F5. Two other signals from the flyback are the ABL (pin 8) and the flyback pulse derived from pin 6. Refer to the video processor section for an explanation of these signals.



<<Figure CA-16>>

High Voltage Shutdown

Another winding from the flyback is used for high-voltage shutdown, commonly referred to as x-ray protection. Activation of the HV shutdown circuit will occur when it detects a 4 to 6 kV increase in the high



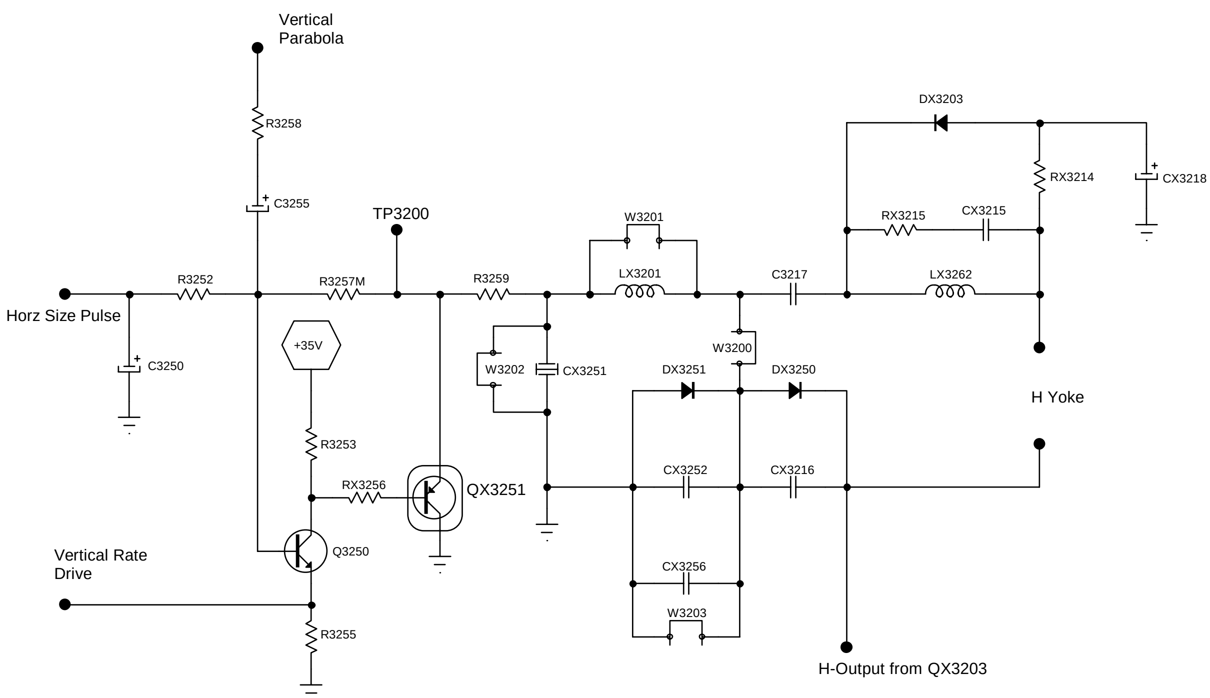
<<Figure CA-17>>

voltage. The HV shutdown circuit utilizes a rectified DC voltage across CX3003. This voltage is applied to a zener diode, ZDX3004, through a voltage divider consisting of RX3013, RX3015, RX3016, and RX3022. The actual value of the zener will vary according to screen size. When this DC voltage becomes high enough, the zener begins to conduct. The resulting voltage can be metered at pin 29 of ICX2200. If the voltage in the shutdown pin is above +3.5 volts, the IC's internal shutdown circuitry will trigger and deactivate all horizontal signal from the IC, thereby shutting off the set. In this case, the microprocessor will have to be reset before the television can be powered on.

Width and Geometry Correction

Width and east/west pincushion correction circuitry may be found on receivers with 27 - 36 inch picture tubes. Smaller sets have pincushion correction preset in the windings of their deflection yokes. Otherwise, width is controlled in the CA chassis digitally through the microprocessor, IC6000, using an internal pulse width modulator. The width control signal is emitted from pin 47 of the microprocessor and is supplied to C3250. This operation is very similar to the vertical size adjustment. The resulting DC voltage effects the biasing of transistor Q3250, thereby changing the current in coil LX3201 and ultimately altering the width.

<<Figure CA-18>>



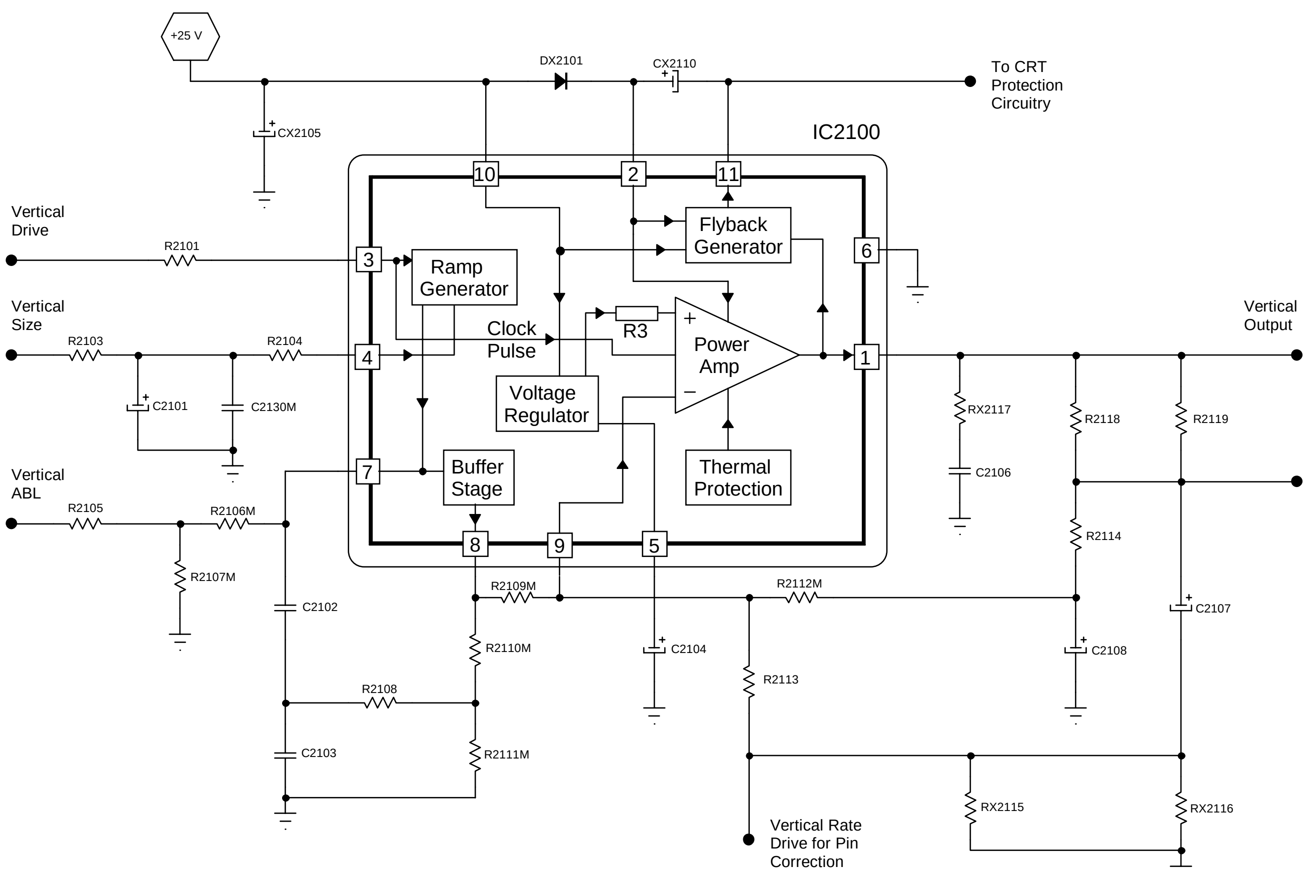
The pincushion correction is accomplished using diode modulation. Key components of this circuit include the width coil, LX3201; the horizontal yoke; CX3216 and CX3252; CX3217, used for S-correction; LX3262, for linearity; DX3250 and DX3251 as dampers; and QX3251 and CX3251, used for amplifying the vertical parabola waveform. This circuit uses the parabolic waveform from IC2100, the vertical amplifier, to shorten the horizontal scan lines on each end of the vertical trace. As the vertical trace is near its extremes, voltage across CX3251 is increased. The result is a lower net voltage across the horizontal yoke coil which translates to less beam deflection. Conversely, when QX3251 modulates a lower voltage across CX3251, particularly when the vertical scan is closer to the middle of its trace, deflection is increased. The

resulting waveform for yoke current is a sawtooth with rounded peaks.

Vertical Amplification

Most of the vertical signal amplification is performed by the vertical amplifier, IC2100. This IC contains a power amplifier, a ramp generator, and a flyback generator and is supplied by +25 volts to pin 10. The initial vertical drive signal which should run at 60 Hz is developed from ICX2200, the video processor. Pin 24 of ICX2200 is the vertical ramp (VRamp) source. This signal is inverted by Q6002 and sent as vertical sync to pin 2 of IC6000. It also travels as vertical drive to pin 3 of IC2100 through R2101. The vertical output signal to the yoke comes from pin 1.

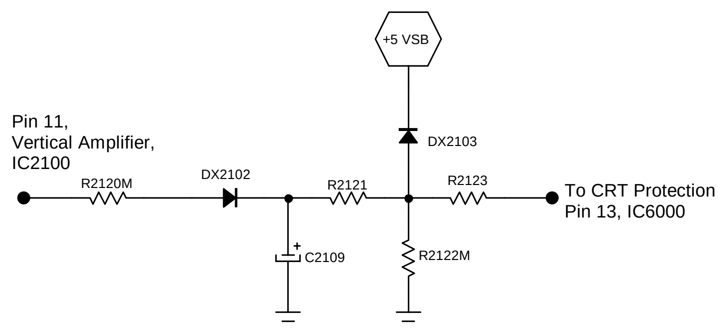
<<Figure CA-19>>



Vertical size is also amplified within IC2100. IC6000 controls vertical size using a pulse width modulated signal emitted from pin 48. The signal generates a DC voltage across C2101. This DC controls vertical height using circuitry inside IC2100. As the width of the pulse changes, a corresponding change occurs in the DC level. In this manner, vertical size may be controlled in the on-screen servicers menu.

CRT Protection

CRT protection is provided for the CA in circuitry off the vertical amplifier. In case of a damaged IC2100 or a shorted CX2107 for example, this circuit will prevent damage to the CRT by shutting the microprocessor off. In turn, this action shuts down the television receiver. The circuit is composed of C2109, DX2102, DX2103, R2120M, R2121, R2122M & R2123. Pin 11, the pump-up, of IC2100 emits a pulsing waveform. DX2102 rectifies this waveform to a DC voltage across C2109. After passing through the voltage divider network formed by R2121 and R2122M, the voltage can be found on pin 13 of IC6000 and should meter between +3.6 and +5.1 volts. Should the voltage be outside this range, CRT protection will trigger. If the CRT protection circuitry is triggered at power on, the television will turn off in 3 seconds. If this occurs, it will be necessary to reset the microprocessor before the television will turn on. Resetting the microprocessor may be accomplished by removing AC to the set for a couple minutes.



<<Figure CA-20>>

Part Location	Part #	Notes
TX3204	095-04372-01	Refer to Service Manual
	095-04601-01	for Corresponding Models
QX3203	121-01383	All Models
IC2100	221-00992-01	All Models

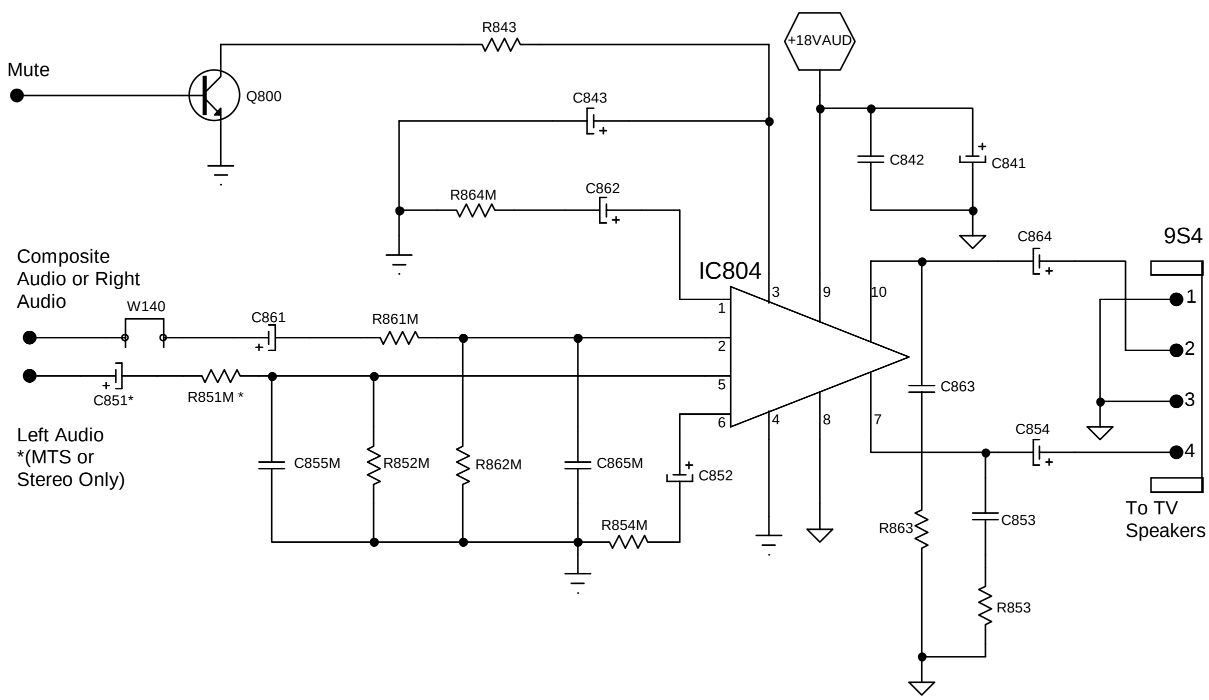
<<Table CA-3>>

CA CIRCUIT DESCRIPTIONS

Audio Amplification

There are three audio circuit configurations used in the various CA chassis: mono, stereo, or MTS (Multi-channel Television Stereo). While few CA receivers are monophonic sets, the mono audio circuit bears mentioning due to the fact that it is used in each of the three circuit variations.

IC804, the audio amplifier IC and heart of the mono audio circuit, is capable of both mono and stereo audio amplification. IC804 has dual audio inputs (pins 2 and 5) and, naturally, dual outputs (pins 10 and 7). These outputs drive 8-ohm, 5-Watt speakers. The audio amplifier utilizes +18 volts audio (+18 AUD) as its power supply on pin 9. Its characteristic voltage gain is 50 dB. However, to eliminate potential noise problems, R854M and R864M are used in conjunction with feedback capacitors C852 and C862 to limit voltage gain. Such an arrangement allows use of a higher power audio signal that is less prone to noise interference. Maximum output to the speakers should not be more than 3 Watts. Pin 3 of IC804 connects the Mute line from pin 14 of the microprocessor to the audio circuit. A high signal on the base of Q800 will turn that transistor on, lowering voltage on pin 3 and causing the amp IC to mute the audio.



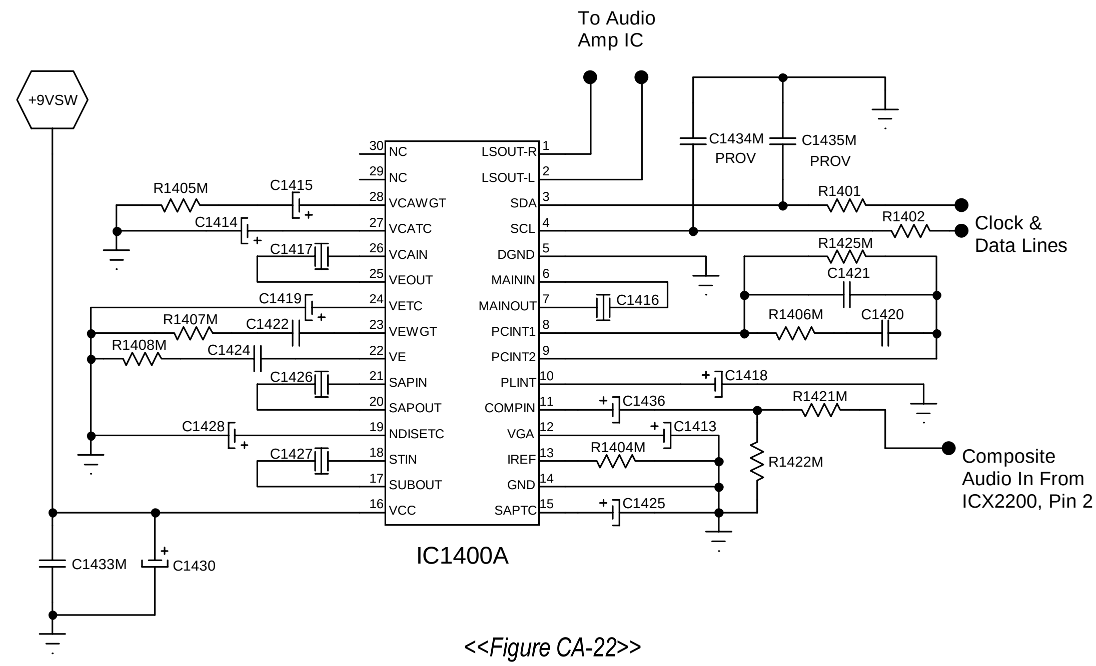
<<Figure CA-21>>

When IC804 is used as a mono amplifier, composite audio comes through C861 into pin 2. When used in a stereo or MTS receiver, pin 2 serves as the right audio channel input, and pin 5 as the left. C861 and C851 (for non-mono sets) are used to pass audio but block any DC. Surface mounted capacitors, C855M and C865M, are used to set the gain cut frequency to approximately 13 kHz. Voltage dividers consisting of R861M and R862M for the right channel and R851M and R852M for the left channel limit the maximum signal input to 42 mVrms. Maximum output from the stereo processor is normally 490 mVrms, which would be too high an input for IC804.

In the mono circuit, composite audio is fed directly from pin 2 of ICX2200 into the audio amplifier circuit. However, on stereo and MTS models, composite audio is fed into IC1400A or IC1400 respectively. Here the composite sound can be separated into left and right audio channels.

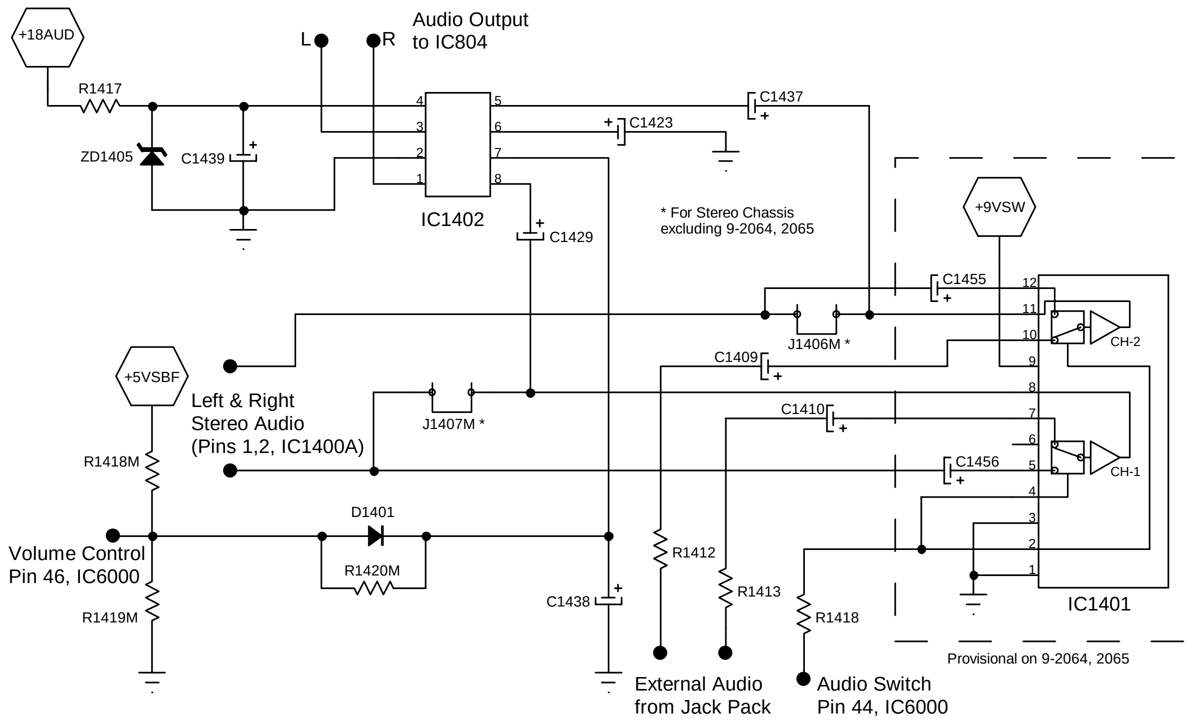
Stereo Processing

In stereo receivers, IC1400A receives composite audio through C1436 into pin 11. Because the 490 mVrms composite audio signal from ICX2200 is too high for the audio processor input, the voltage divider consisting of R1421M and R1422M limit the signal to 245mVrms. This audio processor is controlled by the microprocessor via serial clock and data lines connected at pins 3 and 4. IC1400A is powered by the +9VSW at pin 16. Its right and left channel output exit the IC at pins 1 and 2.



<<*Figure CA-22*>>

External audio input on the stereo chassis is passed to the audio amplifier via IC1401, a microprocessor-controlled switching IC. This IC is powered by the +9VSW at pin 9. When the external inputs are present on a receiver, processed audio from IC1400A will come into the switching IC at pins 5 and 12. External (or auxiliary) audio enters the switching IC at pins 7 and 10. If an auxiliary source is detected by IC6000, a signal from pin 44 of the micro will trigger pins 2 and 4 of IC1401 to switch from internal to external audio inputs. Whichever audio source is selected will be passed from pins 8 and 11 to the volume control IC1402.



<<Figure CA-23>>

IC1402 is powered by the +18AUD at pin 4. Pins 5 and 8 receive the audio input, while the output for right and left channels come from pins 1 and 3 respectively. This volume IC is controlled by a DC level from pin 46 of the microprocessor. Pin 46 emits a pulse width modulated signal that is rectified and smoothed by D1401, R1420M, and C1438. The resulting DC voltage is applied to pin 7 of IC1402. This voltage will vary from +0.5 to +5 volts DC. The gain of this IC is 12dB.

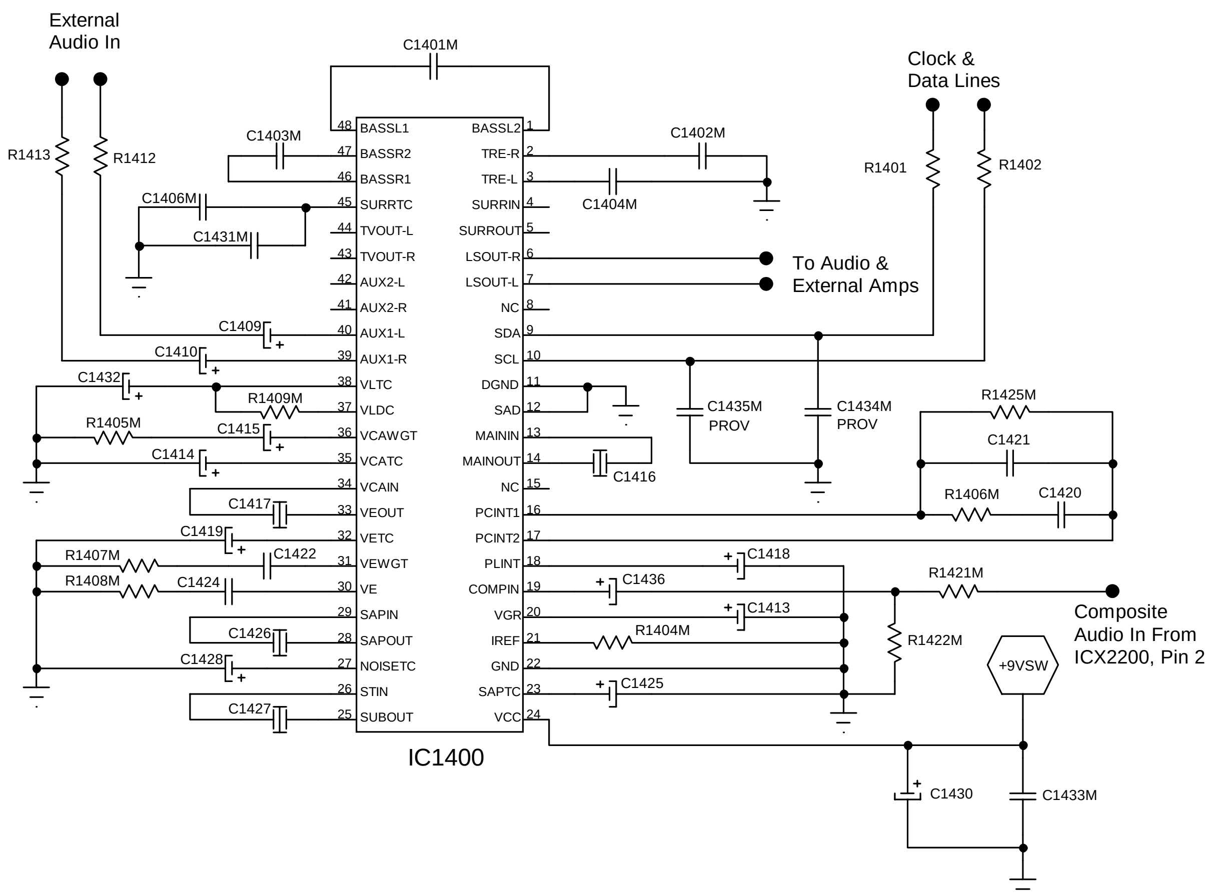
IC Location	Part #	Notes
IC804	221-00598-01	All Models
IC1400	221-01127	MTS Models
IC1400A	221-01382	Stereo Models
IC1401	221-01171	Stereo Models
IC1402	221-01380	Stereo Models

<<Table CA-4>>

MTS Processing

For MTS chassis, IC1400 serves as the sound processor. It features mono, stereo, or SAP settings. It also features adjustable bass and treble levels, balance adjustment, sound-right audio limiting, front surround sound, and speaker cut-off. Furthermore, whereas internal and external source switching is accomplished by a separate switching IC for the stereo sets, the MTS is capable of internally switching between various sources.

<<Figure CA-24>>

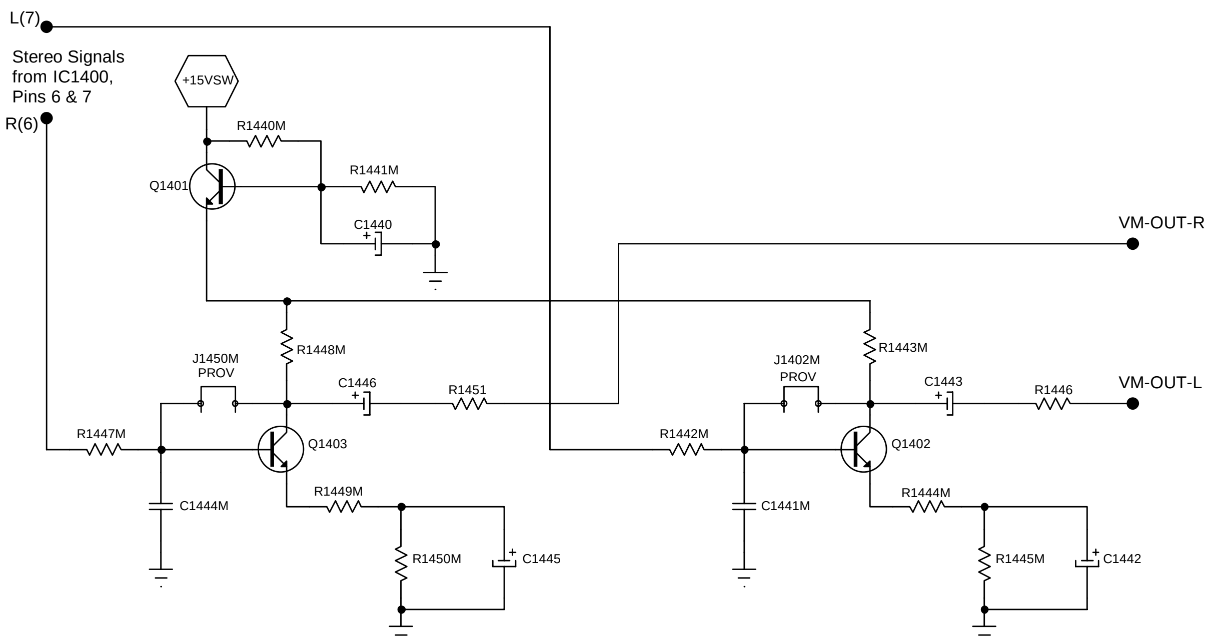


IC1400 is powered by the +9VSW at pin 24. Composite audio enters through C1436 at pin 19. This signal is reduced by a voltage divider consisting of R1421M and R1422M. I²C bus control (serial clock and data) from the microprocessor enters the MTS processor at pins 9 and 10. Information on these lines controls those adjustments as described above as well as the volume. Right and left channel auxiliary input feeds into pins 39 and 40. Audio outputs come from pins 6 and 7 and feed the amplifier circuit in the manner described above.

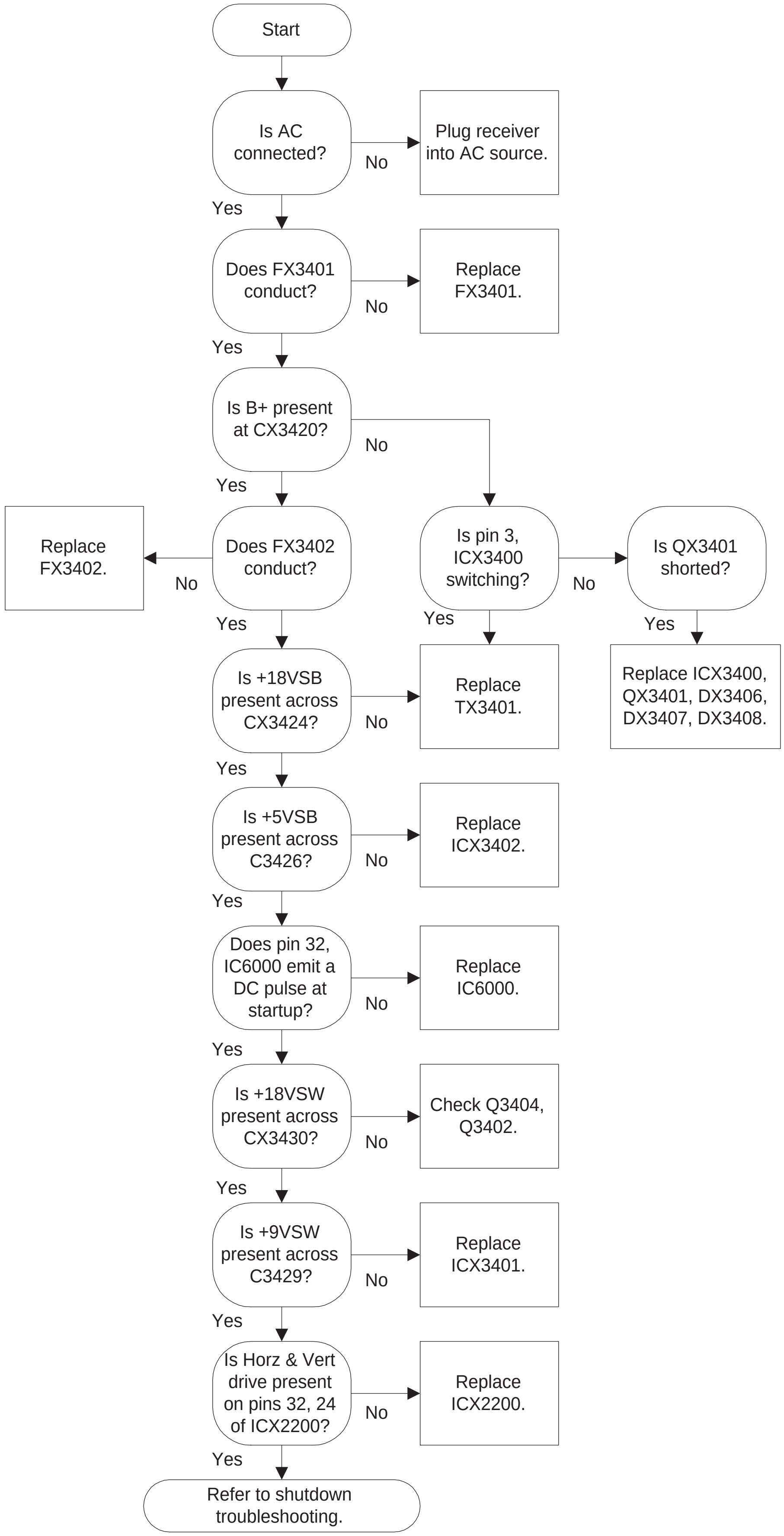
External Audio Output

The output pins here also feed the variable audio output circuitry. This common emitter amplifier has a gain of 12 dB. Q1402 and Q1403 are used to amplify left and right channels respectively. Power for this amplification stage is provided by Q1401, which uses the +15VSW. To reduce popping on the monitors, the switching of Q1401 is briefly delayed by an RC network formed by R1440M and C1440.

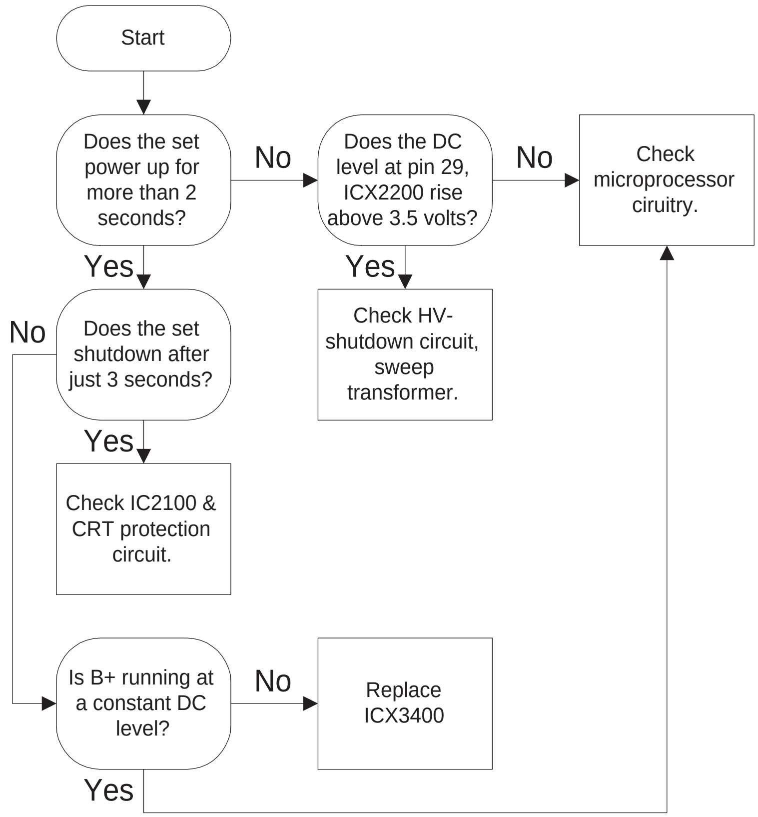
<<Figure CA-25>>



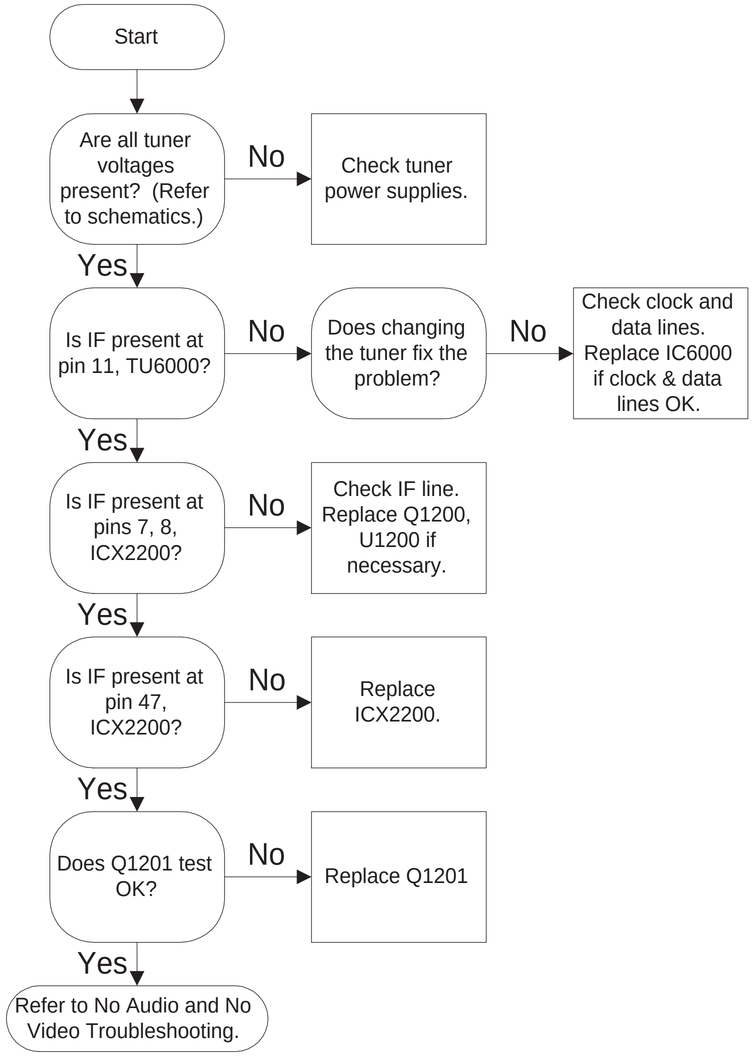
1. No Power


Start
Is AC connected?
No
Plug receiver into AC source.
Yes
Does FX3401 conduct?
No
Replace FX3401.
Yes
Is B+ present at CX3420?
No
Yes
Replace FX3402.
No
Does FX3402 conduct?
Is pin 3, ICX3400 switching?
No
Is QX3401 shorted?
Yes
Yes
Yes
Is +18VSB present across CX3424?
No
Replace TX3401.
Replace ICX3400, QX3401, DX3406, DX3407, DX3408.
Yes
Is +5VSB present across C3426?
No
Replace ICX3402.
Yes
Does pin 32, IC6000 emit a DC pulse at startup?
No
Replace IC6000.
Yes
Is +18VSW present across CX3430?
No
Check Q3404, Q3402.
Yes
Is +9VSW present across C3429?
No
Replace ICX3401.
Yes
Is Horz & Vert drive present on pins 32, 24 of ICX2200?
No
Replace ICX2200.
Yes
Refer to shutdown troubleshooting.

2. Shutdown

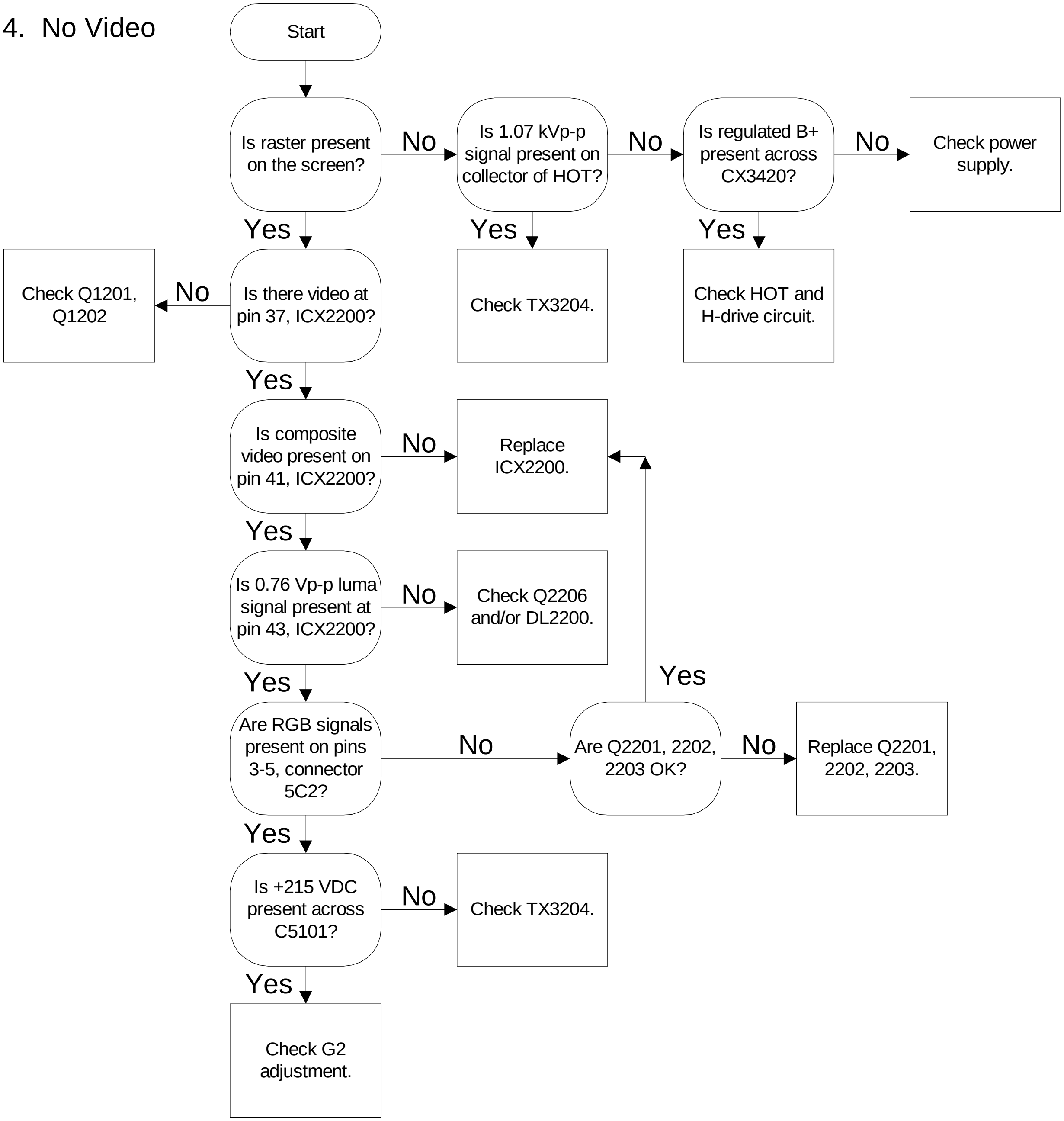

Start
Does the set power up for more than 2 seconds?
No
Does the DC level at pin 29, ICX2200 rise above 3.5 volts?
No
Check microprocessor ciruitry.
Yes
Yes
Check HV-shutdown circuit, sweep transformer.
No
Does the set shutdown after just 3 seconds?
Yes
Check IC2100 & CRT protection circuit.
Is B+ running at a constant DC level?
No
Replace ICX3400
Yes

3. No Tuning

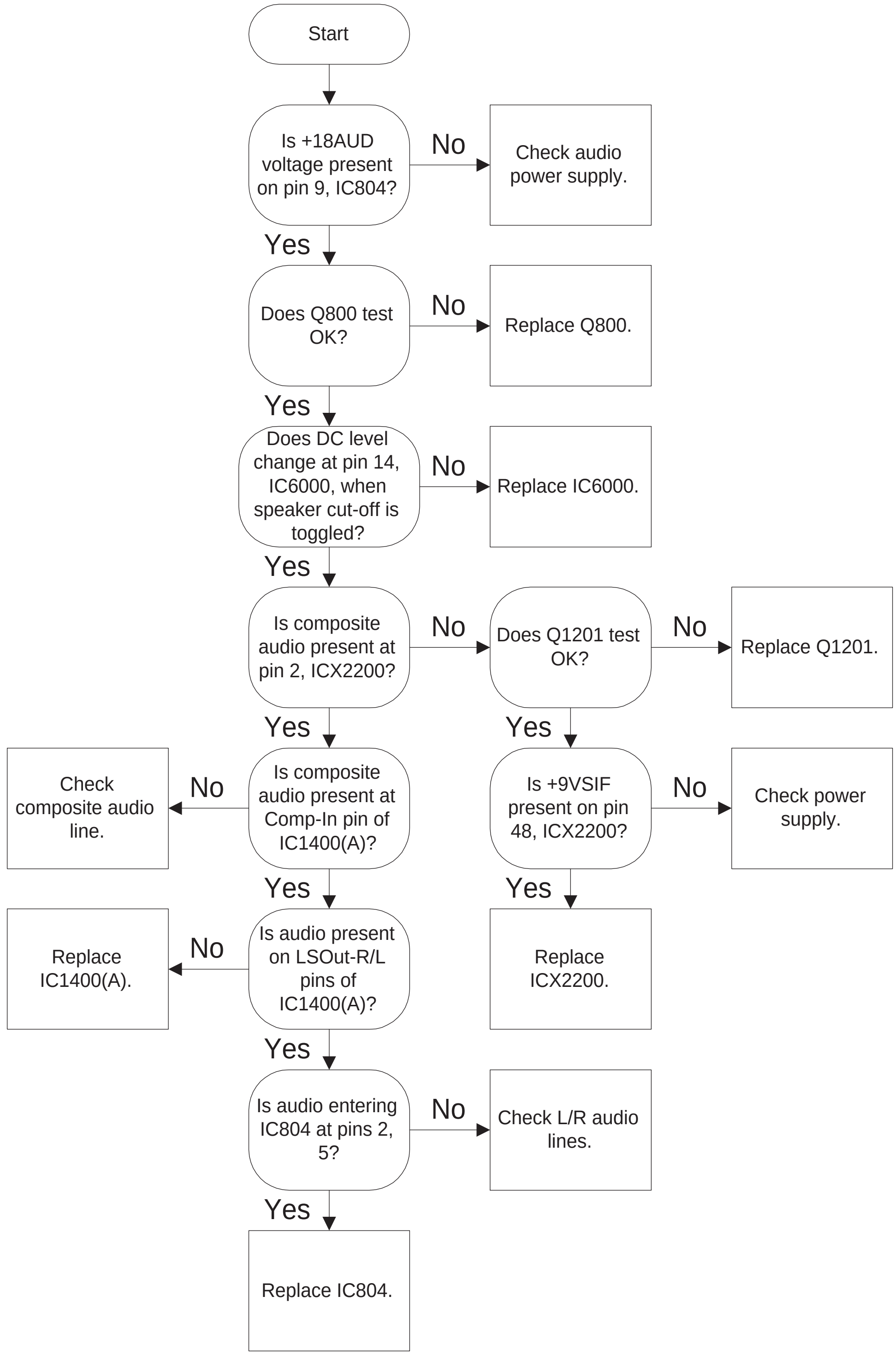

Start
Are all tuner voltages present? (Refer to schematics.)
No
Check tuner power supplies.
Yes
Is IF present at pin 11, TU6000?
No
Does changing the tuner fix the problem?
No
Check clock and data lines. Replace IC6000 if clock & data lines OK.
Yes
Is IF present at pins 7, 8, ICX2200?
No
Check IF line. Replace Q1200, U1200 if necessary.
Yes
Is IF present at pin 47, ICX2200?
No
Replace ICX2200.
Yes
Does Q1201 test OK?
No
Replace Q1201
Yes
Refer to No Audio and No Video Troubleshooting.

CA TROUBLESHOOTING

4. No Video



5. No Audio


Start
Is +18AUD voltage present on pin 9, IC804?
No
Check audio power supply.
Yes
Does Q800 test OK?
No
Replace Q800.
Yes
Does DC level change at pin 14, IC6000, when speaker cut-off is toggled?
No
Replace IC6000.
Yes
Is composite audio present at pin 2, ICX2200?
No
Does Q1201 test OK?
No
Replace Q1201.
Yes
Yes
Check composite audio line.
No
Is composite audio present at Comp-In pin of IC1400(A)?
Is +9VSIF present on pin 48, ICX2200?
No
Check power supply.
Yes
Yes
Replace IC1400(A).
No
Is audio present on LSOut-R/L pins of IC1400(A)?
Replace ICX2200.
Yes
Is audio entering IC804 at pins 2, 5?
No
Check L/R audio lines.
Yes
Replace IC804.

Section 2:
CB Chassis

X-RADIATION

To prevent possible exposure to radiation caused by excessive CRT Anode voltage, the CB Chassis incorporates a “High Voltage Shutdown” circuit. This circuit senses the level of flyback pulse from “Flyback Transformer” representative of the actual high voltage on the CRT anode. When this level exceeds a predetermined voltage, the circuit shuts down the horizontal drive, preventing further generation of anode voltage. In this condition, the horizontal drive is “latched” off. The drive will remain off until the microprocessor is reset.

SHUTDOWN CIRCUIT OPERATION

This shutdown circuit operates by means of sample HV taken from pin 6 of the sweep transformer TX3204. This sample of voltage is rectified, filtered and compared with a reference voltage(fixed by ZDX3004 by the transistor QX3002. When the HV reaches the maximum permitted voltage, the transistor QX3002 enters in conduction mode like consequence the transistor QX3001 also enters in conduction. When QX3001 enters in conduction, the flyback pulses at the entrance of the video processor are 1 volt or less,the the TV goes out and enters in shutdown mode.

When the shutdown circuit is operating, the microcontroller will prevent the TV from being turned on again unless the microcontroller has been restarted by disconnecting the TV from the AC line.

CRT ANODE HIGH VOLTAGE MEASUREMENT PROCEDURE

Each CRT screen size has its own safe operating Anode Voltage and shutdown voltage. Critical Safety components (designated with an “X” in the component designator) are designed to operate the CRT at a safe operating Anode voltage and provide proper shutdown thresholds . If replacement of any of these components are deemed necessary, it is important to use original type Zenith replacement components. After replacement is made, confirm proper Anode voltage using the following procedure.

NOTE: The CB chassis does not have a bleeder resistor to discharge the Anode voltage. High voltage can remain on the CRT Anode long after power is turned off. Before removing the CRT anode connection, turn off and unplug the television, then discharge the CRT Anode to DAG ground.

Measurement of the CRT Anode voltage must be performed using a high impedance high voltage meter, with no visible raster on the screen, and operating at nominal horizontal scanning frequency. Connect a strong broadcast signal (or TV signal generator operating at 15.734kHz horizontal scanning rate) to the RF input.

After discharging the CRT, connect a high impedance high voltage meter to the CRT anode. Turn the television “on” and confirm a good signal is being displayed . Reduce Brightness and Contrast settings until the picture is well extinguished.

Observe the Anode voltage meter reading and compare with the table below for the proper CRT screen size. If the voltage reading is higher that the maximum, verify circuit component values and proper operation.

SCREEN SIZE	B+ VDC (0 BEAM)	HV NOM KV	HV MAX KV
COMPONENT LEVEL REPAIR			
25	124.0 +/- 2%	27	29
27	124.0 +/- 2%	28	29
MODULE LEVEL REPAIR ONLY			
32	128.5 +/- 2%	30	31.5
36	128.5 +/- 2%	30	31.5

SAFETY CIRCUIT TEST PROCEDURE

This shutdown circuit operates by means of a sample of HV taken from pin 6 of the sweep transformer TX3204. This sample of voltage is rectified, filtered and compared with a reference voltage (fixed by ZDX3004) by the transistor QX3002. When the HV reaches the maximum permitted voltage, the transistor QX3002 enters in conduction mode; like consequence the transistor QX3001 also enters in conduction.

When QX3001 enters in conduction, the flyback pulses at the entrance of the video processor (pin 18) are attenuated. If this atenuattion is so that the flyback pulses at the entrance of the video processor are 1 volt or less, then the TV goes out and enters in shutdown mode.

When the shutdown circuit is operating, the microcontroller will avoid that the TV is turned on again unless the microcontroller has been restarted by disconnecting the TV from the AC line.

Equipment required:

a) Video Generator.

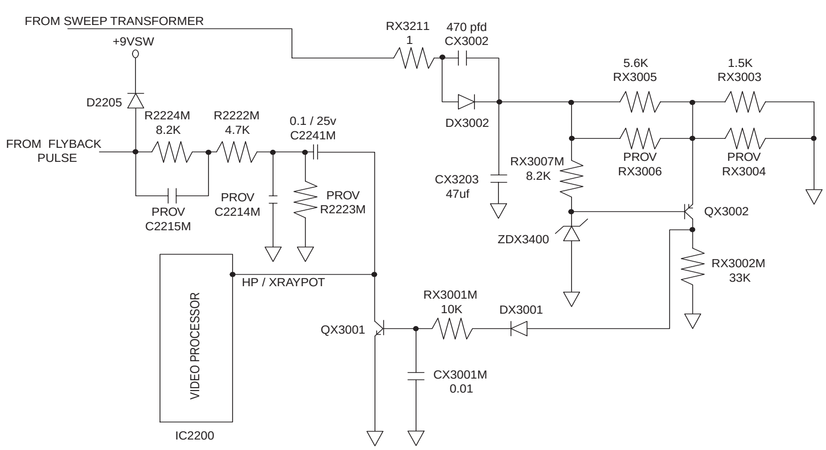
b) HV DC meter (0 to 40 KV, high Z).

c) External variable power supply (0V to 200 VDC @ 5Amps minimum).

d) 1 Giga ohm, 5%, 2W film resistor.

Note: The external power supply may require a diode for blocking voltage from the chassis power supply to the external power supply. The diode should be connected between the positive output of the external power and B+ of the chassis. The cathode should be facing the B+ of the chassis. The recommended diode is Part No. 103-00339-04A (400 V of VRRM @ 3 Amps of average rectified forward current).

SHUTDOWN SAFETY CIRCUIT



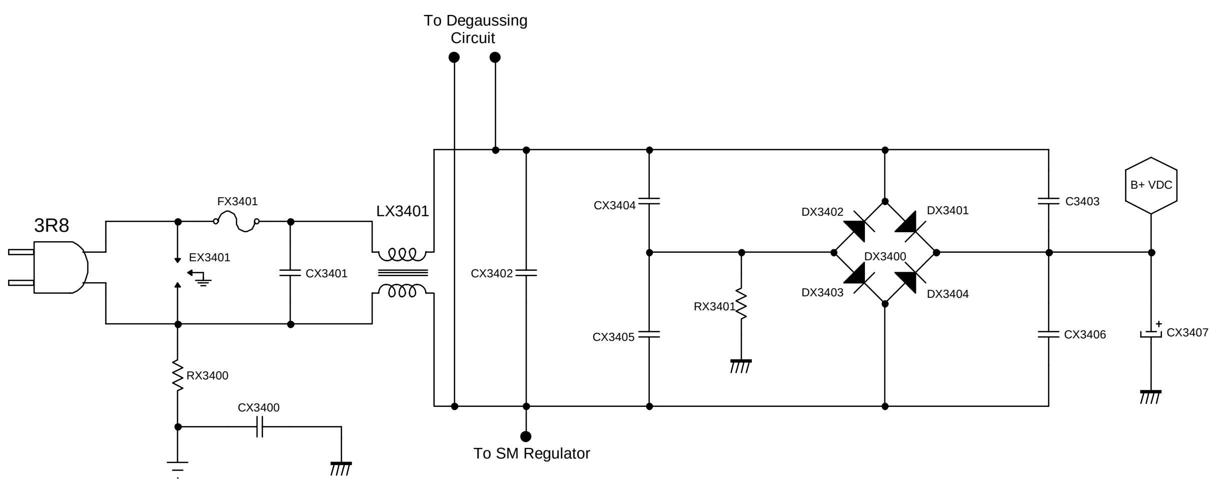
Introduction

The CB chassis is a cold chassis designed to support 27”, 32”, and 36” receivers. Its power supply features a controlled turn-on MOSFET gate driver circuit, direct B+ regulation, thermal protection circuitry, over-current protection (OCP), over-voltage protection (OVP), over-load protection, provision for future universal power input (85VAC – 265VAC), and software controlled degaussing.

As with many SMPS circuits, this one activates as soon as it is connected to AC line current via plug connector 3R8. Depending on the screen size, the CB can draw anywhere from 125 to 140 watts from the line supply. AC operating tolerances range between 90 Vrms and 135 Vrms. Note that while most of the functional portion of the CB chassis is considered to have a cold ground, the rectifier and primary side of the switch-mode power supply have a hot ground.

Switch-Mode Power Supply Primary Side

FX3401, a 4 amp/250 volt fast-blow fuse, protects the CB chassis from AC line surges. EX3401, the spark gap, also provides some protection for the set. Incoming AC passes the fuse and is filtered by LX3401, CX3401, and CX3402. The switch-mode power supply (SMPS) uses a fairly standard bridge rectifier arrangement to develop raw B+, the voltage that runs the SMPS and ultimately the entire television set. DX3400 is the packaged bridge used in 32” and 36” sets. The 27” sets use discrete diodes DX3401, 3402, 3403, and 3404. Rectifier output (raw B+) will be somewhere between 127.3 and 190.9VDC. This VDC is smoothed by and can be measured across CX3407.

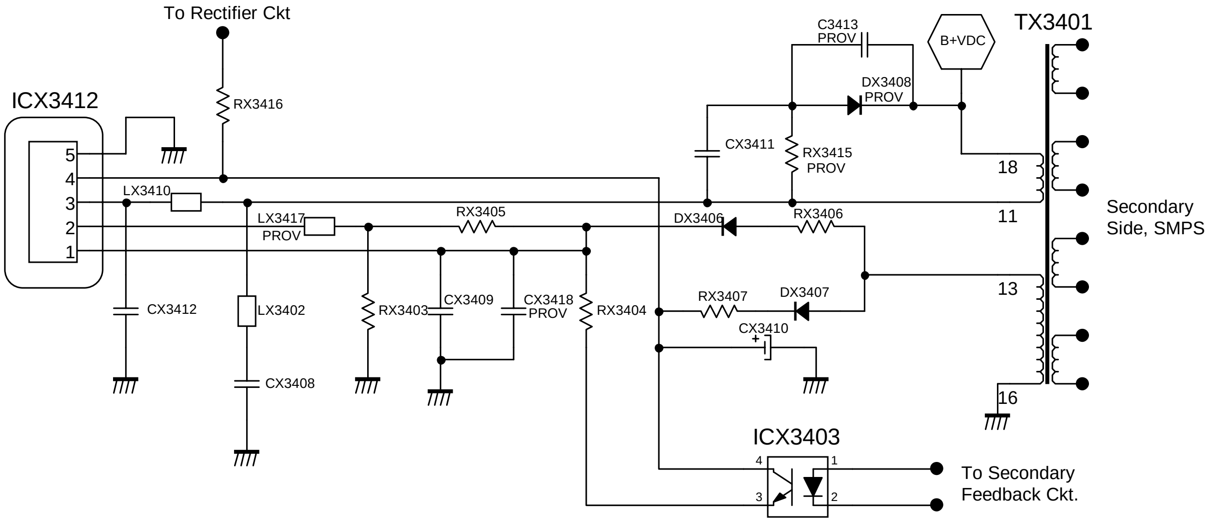


<<Figure CB-1>>

ICX3412 is the switch-mode regulator IC used to develop the numerous individual power supplies off the secondary side of TX3401, the chopper transformer. The same chopper is used in all three of the CB sizes. This transformer isolates the hot portion of the chassis from the cold portion. Raw B+ feeds into pin 18 of the chopper. The other end of this coil, pin 11, connects with pin 3 of ICX3412. Pin 3 is the drain of the internal MOSFET that drives the chopper transformer, while pin 2 serves as the MOSFET source.

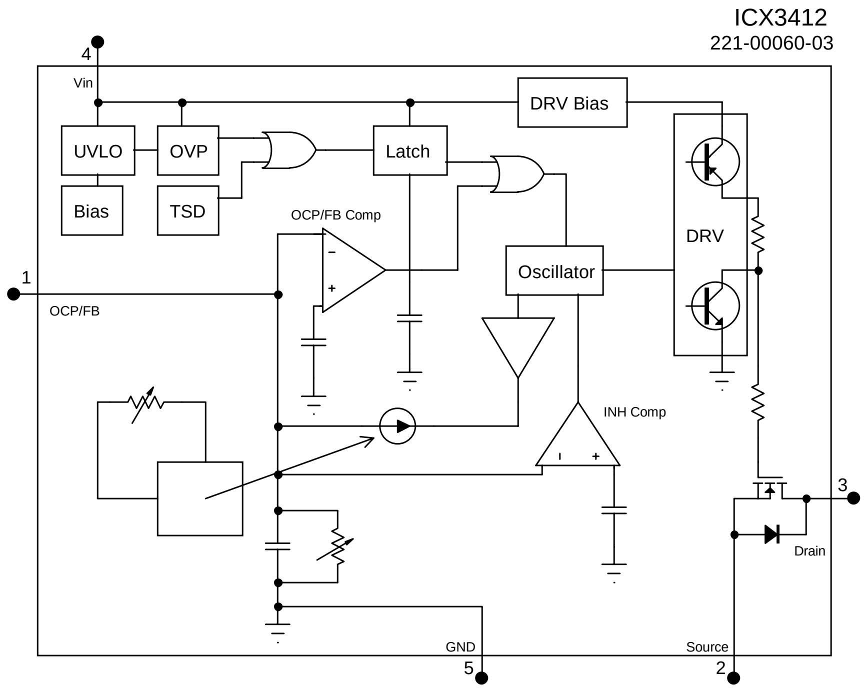
ICX3412 functions when the voltage on pin 4 reaches +16 volts DC. This voltage is developed on CX3410. As it starts, the regulator pulls nearly 20mA of current from CX3410, causing its voltage to

briefly drop. However, as the regulator begins to operate, it drives the chopper, and power derived from pin 13 of the transformer is drawn through DX3407 to maintain the voltage on CX3410. Overload and over-voltage protection are both internal to the regulator IC, and sensed through pin 4. Should either of these conditions occur, and latch will deactivate the oscillator inside ICX3412, thus eliminating any power supplied by the chopper.



<<Figure CB-2>>

Pin 1 of the regulator IC allows feedback input for voltage regulation. Control voltage is supplied to this pin via ICX3403, an opto-isolator that receives output information from the secondary side of the chopper, particularly from the regulated B+. This feedback is accomplished by the programmable reference device, ICX3406. The output from this IC is fed to the opto-isolator, which then communicates this signal back to the switch mode regulator circuit. The output voltage error derived from ICX3403 puts a DC bias across RX3405 and a drain current ramp on RX3403. The net effect of both the output voltage error and drain



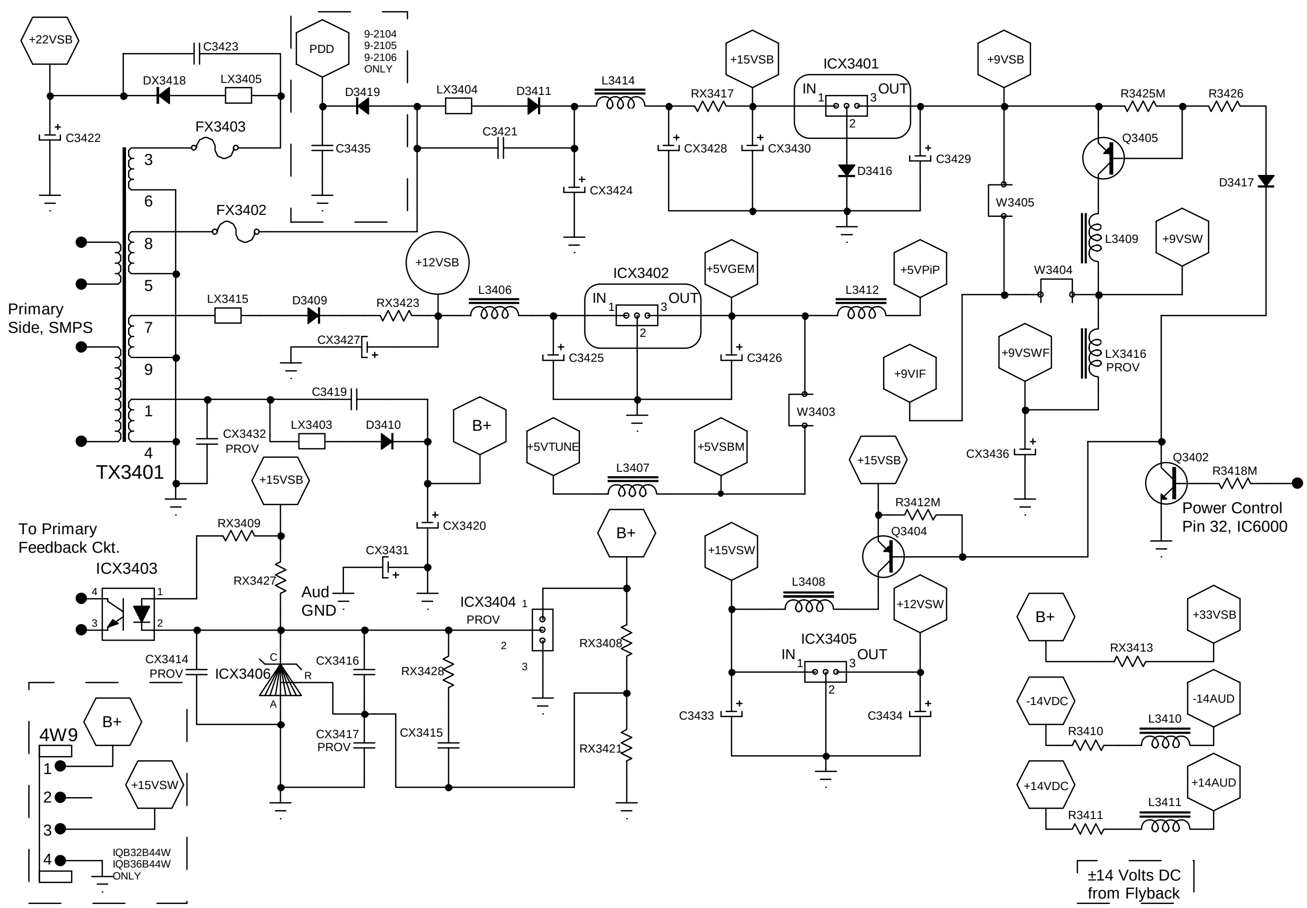
<<Figure CB-3>>

current ramp is input into pin 1 of ICX3412. This signal is then used to determine how regulation shall occur as described below. OCP is also sensed using this pin. To prevent a false over-current detection at startup however, a constant current sink has been included in the regulator. This measure is necessary due to a current spike that often occurs at startup due to primary capacitance discharge.

The switch-mode regulator makes use of the resonant frequency set up by the chopper transformer and CX3408. This resonant frequency as well as the internal oscillator determines the nature of the MOSFET's switching. Hence, the term quasi-resonant may be applied to this regulator. Regardless of the terminology used, the IC regulates voltage based on the following simple rule: duty cycle on-time reduces as voltage rises, while duty cycle off-time reduces as load rises. In this manner, correct voltage is maintained at the chopper transformer. The regulator's fundamental switching frequency is 20 kHz, but when the receiver is switched on, the regulator will operate as high as 100 kHz.

Switch-Mode Power Supply Secondary Side

The secondary side of TX3401 makes use of four separate windings, each with its own half-wave rectifier, to develop the various voltages required by the television set. As a result there are four primary stand-by voltages (VSB): B+ (typically +130 volts), +12VSB, +15VSB, and +22VSB. The +15 and +22VSB are each protected by 3A/250V, slow-blow fuses, FX3402 and 3403. The B+ line has sufficient protection from the switch mode regulator. RX3423 is a fusible resistor that protects the +12VSB line.



<<*Figure CB-4*>>

The B+ provides power for deflection via the horizontal output transistor (HOT), QX3204, and for the tertiary voltages that come from the flyback transformer, TX3204. It also develops the +33VSB for the tuner through RX3413. The +12VSB is regulated down to +5VSB by ICX3402. This +5 volt source powers the microprocessor and EEPROM (IC6000 and IC6001 respectively), the Gemstar® board, the PiP board, and the tuner. The +15VSB is used as is to power sweep correction, horizontal drive amplification, and the ABL circuitry. It is also regulated by ICX3401 for +9V and by ICX3405 for +12VSW. Both of these voltages are used as various video and IF supplies. The +22VSB is used to power the audio amplifier.

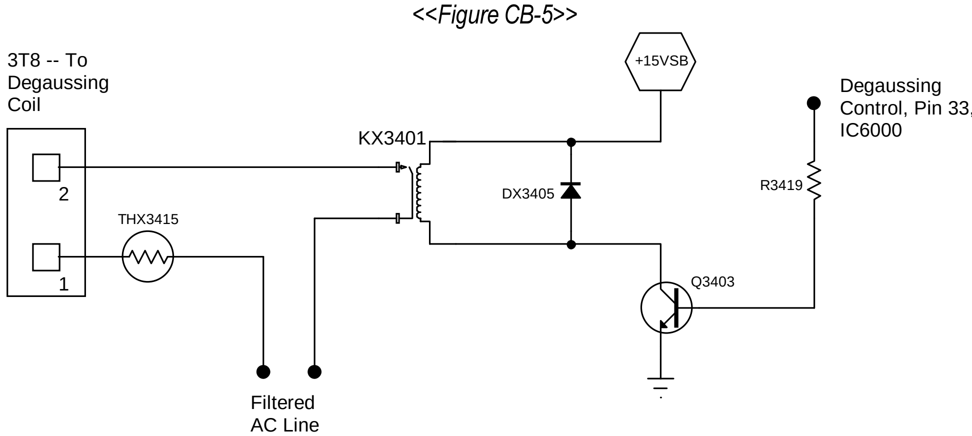
Two other voltages should be named here, although they are developed from the sweep transformer, TX3204. Namely the + and – 14VDC pass through the secondary of the switch mode power supply section. These become the +/- 14AUD volts that power the variable audio output amplifier when they pass the series resistor and inductor arrangement shown on the schematic.

Some of the above voltages are switched on when the television powers up, rather than when it is just plugged in. These include +9VSW, +9VIF (some models), +9VSWF, +15VSW, and +12VSW. These are switched upon receiving a power on DC level from pin 32 of the microprocessor, IC6000. This switches Q3402, which in turn activates both Q3405 and Q3404.

Degaussing Control

Degaussing is software-controlled by a signal from IC6000. When the receiver is switched on, pin 33 emits a 760 ms signal that closes the degaussing relay, KX3401, via Q3403. This allows a brief moment of AC current to magnetize the degaussing coil before the thermistor, THX3415, limits the coil's power.

<<Figure CB-5>>



Part Location	Part #	Notes
ICX3401	F-52403	All Models
ICX3402	F-53046	All Models
ICX3403	162-00028-01	All Models
ICX3405	221-00167-05A	All Models
ICX3406	221-00265-03A	All Models
ICX3412	F-53857	All Models
TX3401	095-04576	All Models

<<Table CB-1>>

Introduction

The CB chassis employs IC6000 as its microcontroller. All end user and servicer controls are accessed using this IC. While most of its functions will be described in terms of how they are used by other devices in the receiver, a number of facts concerning the microprocessor and its input devices will now be presented.

The microprocessor's job is to communicate control instructions and feedback information to and from various other processors and input devices in the set. These include the video, audio, PiP, Gemstar®, audio & video switch ICs, the tuners, the EEPROM, the keyboard and IR detector, and the reset IC. Some of these use a direct connection via either switch, variable pulse, or DC level for communication. Others rely on the I^2C bus, also known as serial clock and data bus. IC6000 provides 2 sets of clock and data lines. The first set is pins 37 and 39, and the second is on pins 36 and 38.

Input Devices

The IR detector demodulates pulses from the 40 kHz modulated carrier and sends the pulses to pin 15 of the microprocessor. There a special algorithm interprets the pulses as the various commands they represent. The keyboard is only slightly more complicated in its operation external to IC6000. It works by varying voltage on only two input pins (7 and 8) using resistor networks. A/D converters inside the micro interpret the different voltages. Because voltage detection is used rather than active keyboard scanning, keyboard radiation is not a problem, but maintaining a +5VSB to within ±4% is critical. Both keyboard and IR information enter the CB chassis through connector 2K6.

Microcontroller

VDD is provided to pin 27 of the microprocessor from the +5VSBF supply. While this voltage is relatively low, IC6000 is fairly demanding in terms of current. This same voltage powers the keyboard and IR detector. The +5VSBF is also used as analog VDD and enters the micro at pin 18.

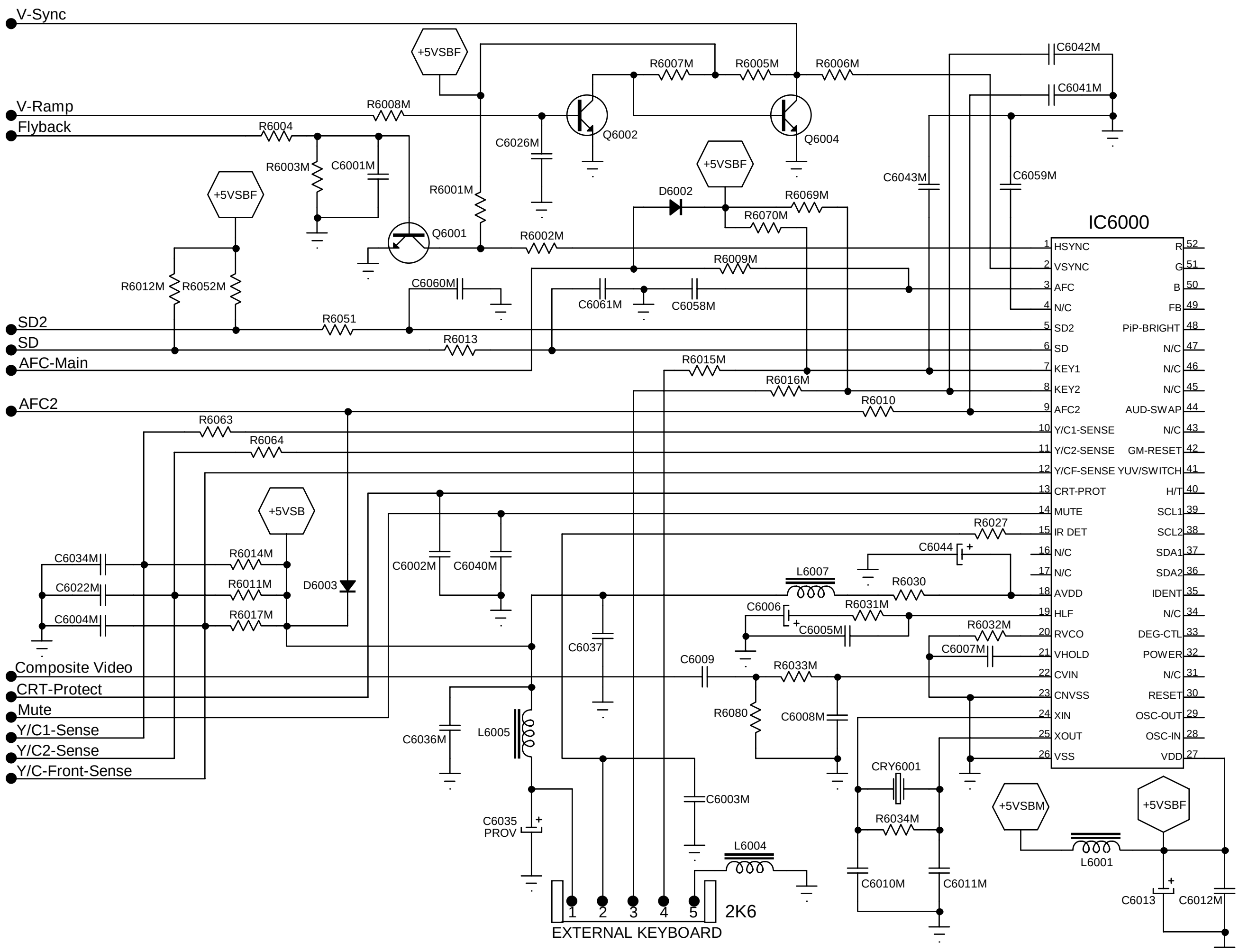
IC6002 serves as a reset IC for the main microprocessor. Note that it comes in a transistor type package. It accurately resets the micro after a power failure is detected. Pin 30 is the reset signal input for IC6000. The micro enters reset state after detecting a low on pin 30 of 2µS or more.

When the micro receives a power on signal from either the keyboard or the remote, the degaussing control pin 33 turns on the degaussing circuit for 760ms. At the same time a constant voltage level from pin 32 turns on the switched voltages in the power supply.

Horizontal and vertical synchronization pulses are fed into pins 1 and 2. These provide the microprocessor the current sweep location of the beam, which is necessary to correctly interrupt main video for various types of on-screen display (OSD). Neither of these sync pulses come directly from the IC2200 where they are first produced. Horizontal sync is actually fed back from the sweep transformer on the flyback pulse line. Vertical ramp signal coming from pin 5 of IC2200 feeds the base of Q6002. Sync is produced on the collector and fed to the vertical amplifier and through R6006M to the V-Sync pin of the micro. OSD or CC (closed captions) are sent as processed RGB (red, green, & blue) from pins 50, 51, and 52. At those times it is necessary to blank out part of the main video, a fast-blank (FB) pulse is sent to the video proces-

CB CIRCUIT DESCRIPTIONS

sor from pin 49 along with the processed RGB. An exception to this occurs when Gemstar® is displayed. Under that circumstance, the fast-blanking pulse without RGB is sent to the video processor via the Gemstar® board.



<<Figure CB-6>>

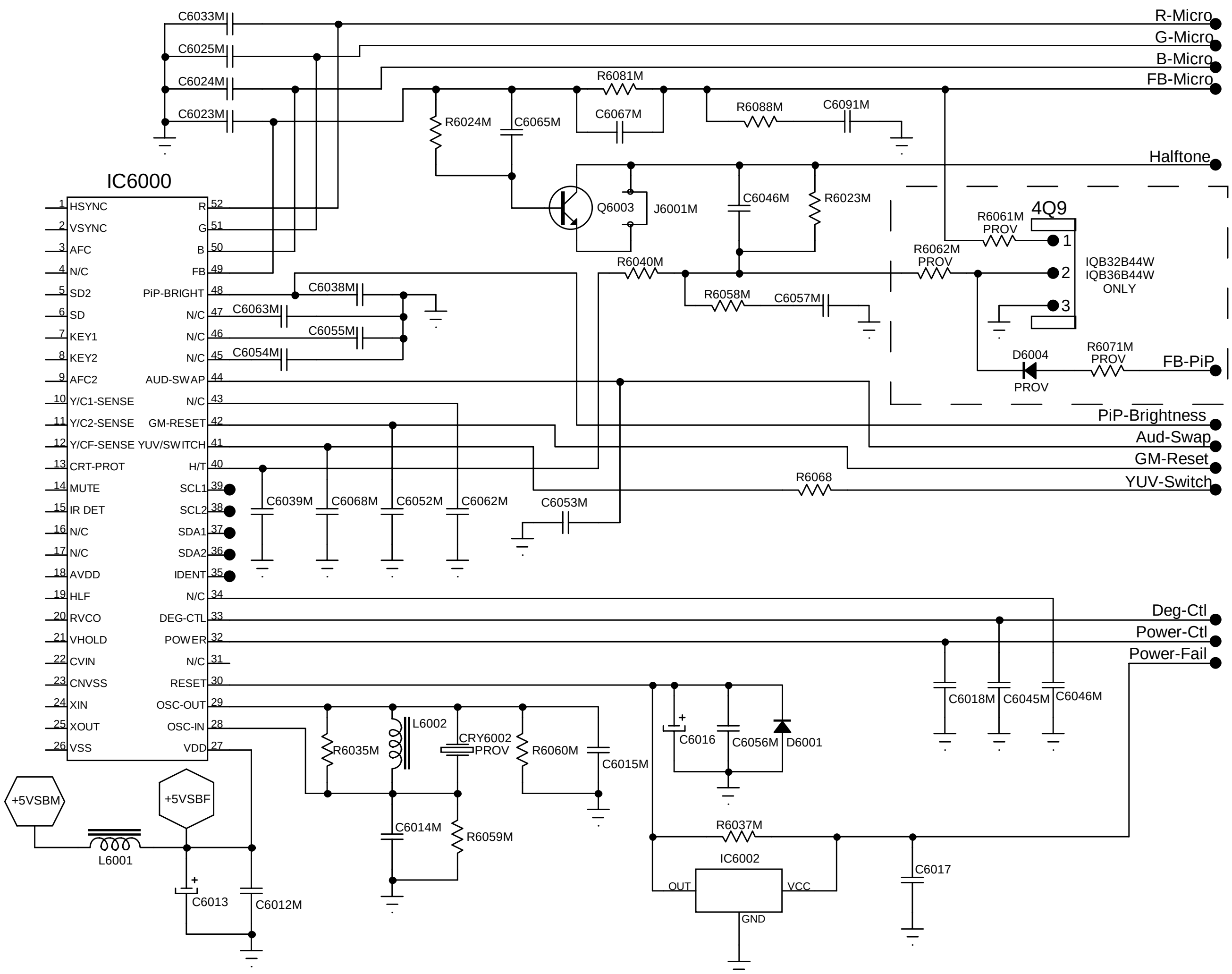
The CB chassis features a halftone function that dims video surrounding OSD. This halftone circuit is described in the video section, but is controlled by a DC level from pin 40.

Closed captioning display is accomplished in the microprocessor by use of the composite video into pin 22. Here a data slicer extracts the caption information and outputs it to the RGB pins when captioning is requested by the user. Note that when OSD needs to be on the screen, such as after a channel change or during a volume change, the OSD will have priority, and CC will mute until OSD turns off.

Pins 5 and 6 are signal detection pins. When the either of the chassis' two tuners detects a bona-fide signal to the video processor, it separates horizontal sync signal from the IF and sends it to this portion of the microprocessor. It can then be used to determine if a certain channel is carrying a valid active broadcast.

Automatic frequency correction (AFC) is sent to the microprocessor via pin 3 and pin 9 (for the second tuner IF). The DC level on either pin tells the microprocessor if it needs to communicate an adjustment to

the corresponding tuner to allow for clearer channel reception. The ideal voltage level here should be between +2.25 and +2.5 volts.



<<Figure CB-7>>

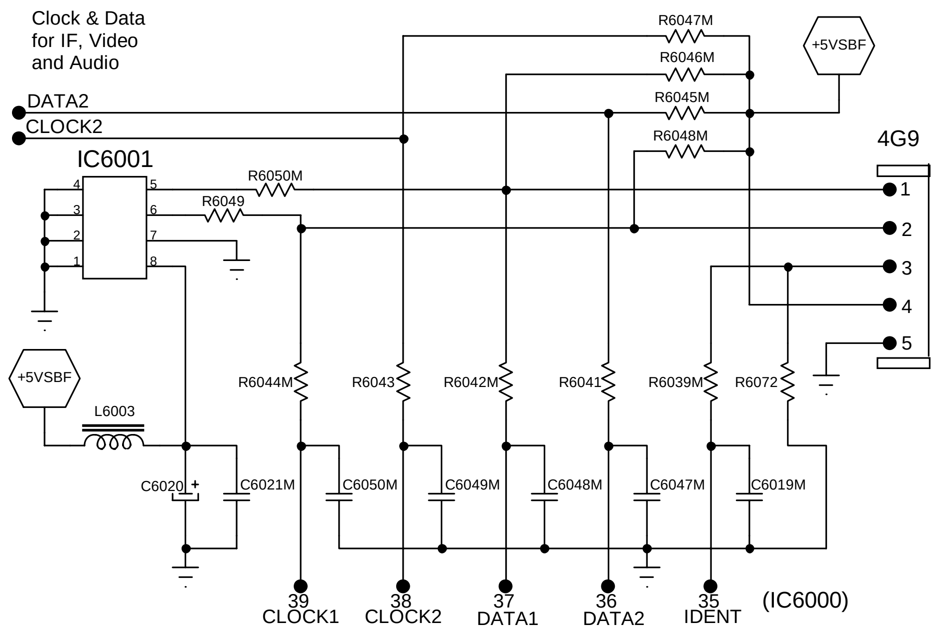
IC6000 provides CRT-protection for the set through pin 13. Operation of this shutdown depends on a DC level from the CRT protection circuit off the vertical amplifier circuit. Should the vertical IC2100 fail, the DC level will no longer be present. In this situation, the CRT-protection latch will shut the receiver down three seconds after detecting the failure. This circuit will prevent the CRT from burning a horizontal phosphor line in the center of the screen or, worse yet, cutting the yoke end of the tube off completely.

The remainder of the I/O pins on IC6000 are briefly described here. Where necessary, a more detailed description will be provided in the circuit descriptions to which they relate. Pins 10, 11, and 12 are used as S-Video (Y/C) detection for the two Y/C jacks on the back and the Y/C jack on the front (where available). Pin 48 emits a varying DC level that changes the bias on Q2211, effecting the PiP brightness of the RGB input to IC2200. Audio swap is accomplished by pin 44, which varies a DC level to a transistor array in the IF section. This array allows the audio signal being heard by the user to be switched between the primary and secondary IF. Pin 42 controls the Gemstar® module's reset function. Pin 41, the YUV-SW varies a DC level on pin 36 of IC2200 to make it switch main video between separated luma and chroma

signals entering IC2200 at pins 4 and 2 respectively and component video entering at pins 37 through 39. Note here that component video cannot be used as PiP. Lastly, pin 14 of IC6000 switches a DC level to alter the mute state of the audio amplifier.

Memory

The EEPROM, IC6001, is a small but vital part of the CB receiver. This 512 byte memory chip is responsible for storing servicer adjustments, channel information, and user settings, even when power is removed from the set. This information is transferred on the clock and data lines from the micro into pins 5 and 6. The EEPROM is powered by the +5VSBF source at pin 8.



<<Figure CB-8>>

IC Location	Part #	Notes
IC6000	221-01388	All Models
IC6001	221-00745-05	All Models
IC6002	221-01177A	All Models

<<Table CB-2>>

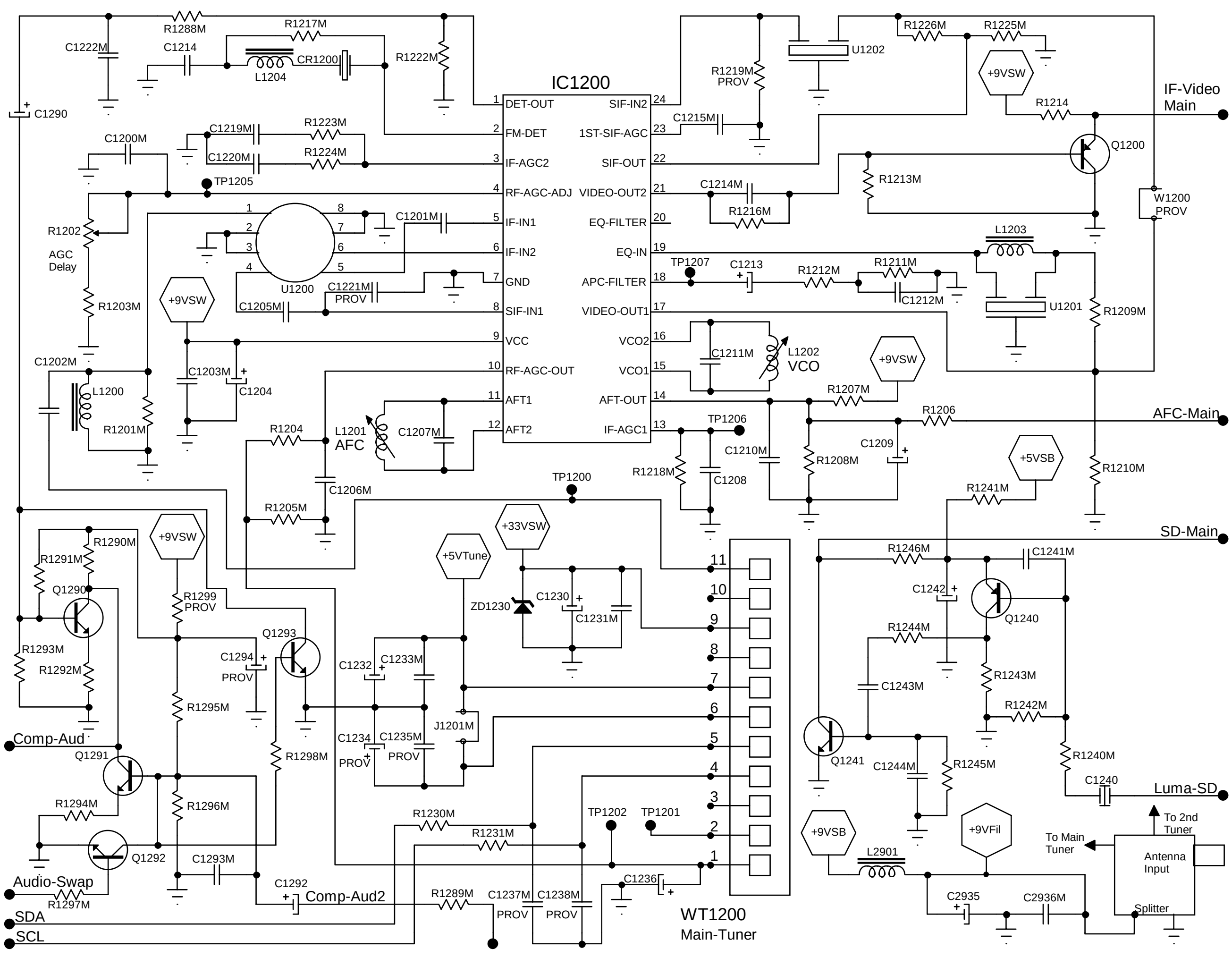
Introduction

The CB chassis utilizes two tuners in order to provide PiP without requiring a second external source. This is with the provision that the receiver's antenna input is receiving multi-channel input. For example, a cable decoder box usually only provides a single channel input. Although the television possesses two tuners, each is receiving an identical single channel, so a second external source would have to be used here if the user desires his PiP to be different from the main screen. On the other hand, a standard cable input or even a regular antenna provides multiple channels that each tuner can demodulate individually.

The IF (intermediate frequency) section can be broken up into a half for each tuner. Those part designations numbered from 1200 through 1249 relate to the primary tuner, WT1200. Part designations from 1250 to 1289 apply to the secondary tuner, WT1250.

Tuner

For the most part, each tuner is fairly identical to the other as it relates to the rest of the chassis. Each corresponds respectively to IF IC1200 and IC1250 (IFPs or IF processors), which are also identical. IF

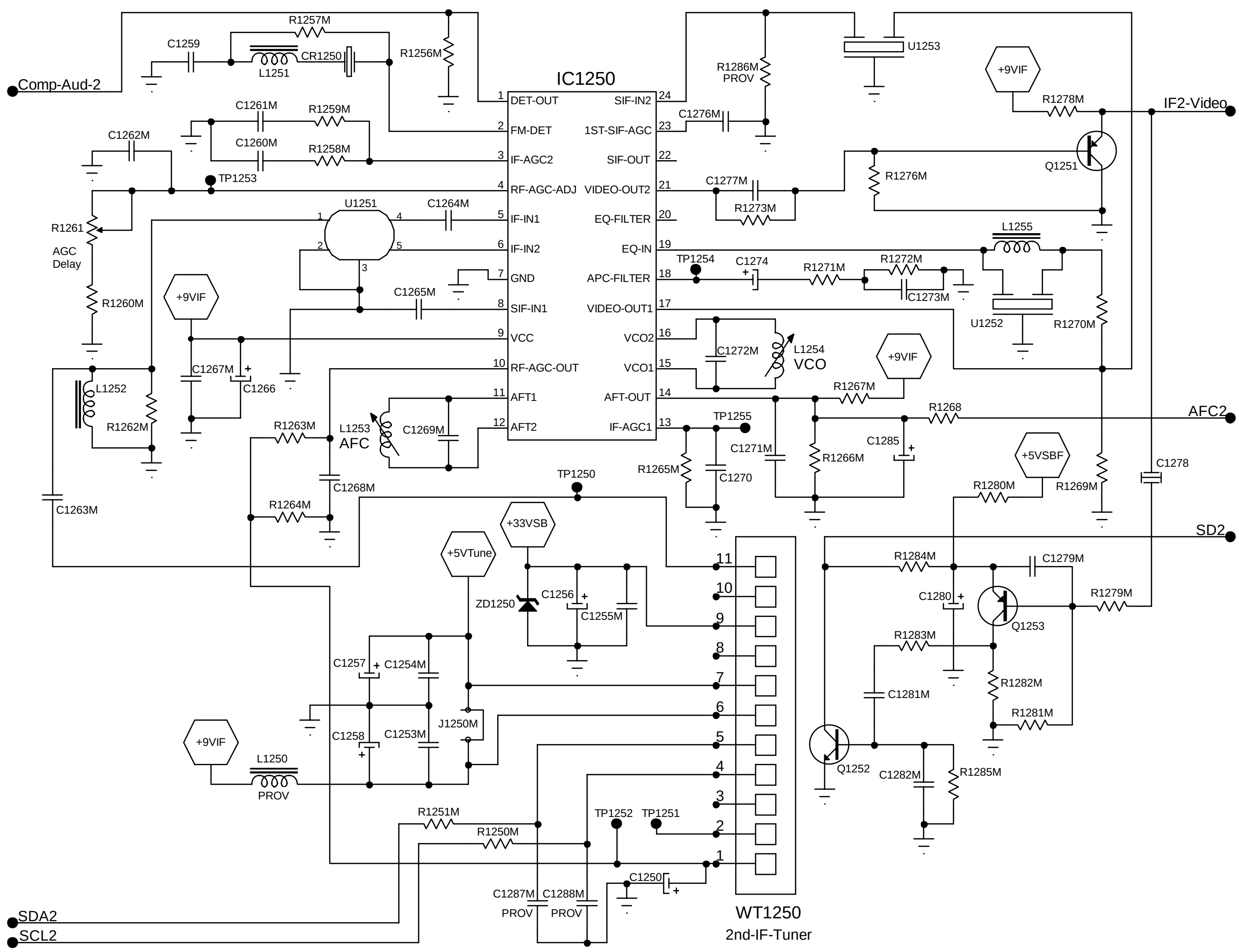


<<Figure CB-9>>

comes from pin 11 of the tuner, is filtered, and is fed into pins 5 and 6 of the IFP. AGC (automatic gain control) voltage is applied to tuner's pin 1 from pin 10 of the IFP. The +33VSB tuning voltage is applied to pin 9, while the +5VTune processing voltage is on pin 7. Clock and data lines from IC6000 communicate with the tuner on pins 4 and 5. In some receivers, the secondary tuners use the +9VIF at pin 6.

IF Processing

Each IFP is powered by the +9VSW on pin 9. After IF is received at pins 5 and 6, sound IF is separated from picture IF emitted from pin 17. It reenters the IFP through pin 24 and finally exits through pin 1 as a composite audio signal. Composite audio from each IFP enters a switching transistor array with part designations 1290 through 1299. The audio-swap line from the microprocessor controls Q1292. This transistor switches the rest of the array between composite audio from either the primary or secondary tuner.



<<*Figure CB-10*>>

Two variable coils are available with each IF processor for adjusting AFC or VCO. Use caution when adjusting these, and be certain to mark their initial position in case they need to be adjusted back to their previous setting. A potentiometer is also available off pin 4 of the IFP. This adjusts the AGC delay inside the processor.

The remaining outputs of the IF processor are the AFC control to IC6000 from pin 14 and the IF video signal which passes through the AV-switch (IC2900) as it travels to the comb filter. AFC output voltage causes the microprocessor to determine any frequency corrections the tuner needs to make for a better signal. A portion of the luma from the IF-video is separated and filtered for the purposes of signal detection at pins 5 and 6 of IC6000. From the main video signal, this separation occurs after the comb filter stage, where composite video exits IC2900 at pin 34. Signal detect information (SD) is then separated from the luma by transistors Q1240 and 1241 and their surrounding circuitry. For the second video signal, luma is taken immediately from the IF video signal out of IC1250 and separated by the circuitry including Q1252 and 1253.

Part Location	Part #	Notes
IC1200	221-00792	All Models
WT1200	175-02770	All Models
IC1250	221-00792-01	All Models
WT1250	175-02770	All Models

<<Table CB-3>>

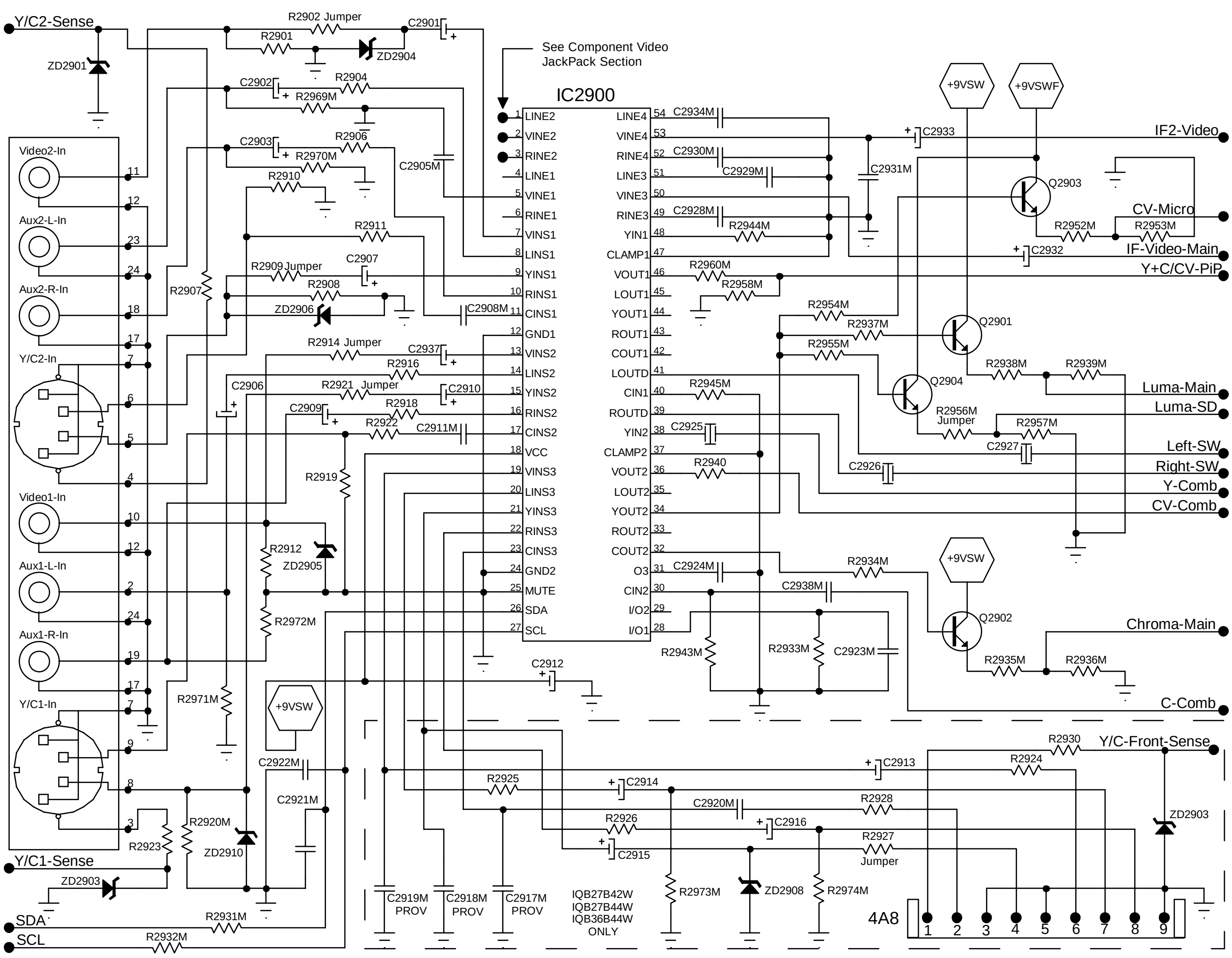
CB CIRCUIT DESCRIPTIONS

Jack-Pack

The CB chassis provides multiple means for connecting external sources that supply video and audio signal. These provisions include two composite video (CV) inputs, two S-Video (Y/C) inputs, component video (YUV) input, corresponding left and right channel audio inputs for each video input, and, in some models, a front input jack featuring CV, Y/C, and stereo audio inputs. Additionally, a two-channel variable audio output is provided. This portion is discussed further in the audio circuit description.

Audio/Video Switch IC

In order to handle the multitude of incoming signals from the jack-pack, as well as the two internal IF signals, the CB chassis employs an analog audio/video IC2900. This IC is powered at pin 18 by the +9VSW. While switching is analog, IC2900 is digitally controlled through the I^2C (serial clock and data) bus connection at pins 26 and 27. This data stream communicates both user selections for signal input as well as microprocessor priority commands. These priority directives may be explained by the following example.



<<Figure CB-11>>

Suppose the user has composite video connected to the Video 1 input and S-Video connected to the S-Video 1 input. If the user selects video source 1 in the customer menu, the receiver must choose between the CV and the Y/C signal. Each Y/C input has a sensor line that feeds the micro. If the micro detects the presence of Y/C on video 1, IC6000 will direct the A/V switch to use that Y/C signal instead of the CV. Thus if it is present, Y/C has priority over CV.

IC2900 features three functional input arrays for jack-pack signal. Each array consists of left and right (L/R) channel audio input, CV input, and Y/C input. Additionally, the A/V switching IC provides another input for the dual IF-video signals and input for the Y (luma) portion of the component video input as well as its associated audio. CV, Y, and IF inputs should scope near 1.0Vp-p. Color burst from the Y/C inputs as well as audio inputs should scope about 300 mVp-p.

For outputs, IC2900 uses pins 39 and 41 for L/R channel external audio. This is fed to IC1400, the audio processor and is used if the user selects a jackpack source. Pin 41 serves as the PiP video output. PiP video is sent as a composite video signal. However, if the PiP source is S-Video, IC2900 internally combines the Y and C signals into a CV signal. PiP CV should have a strength of 2.0 Vp-p at pin 41. Main video is output to the video processor on pins 32 and 34 as chroma (C) and luma (Y), respectively. The luma signal should be 2.0 Vp-p while chroma is about 600 mVp-p.

Composite or IF video input to the IC cannot be passed to IC2200 as composite video. Rather, the A/V switch passes CV or IF video via pin 41 through the comb filter section, where it is separated into luma and chroma and returned to pins 38 and 30 of IC2900. Voltage at pin 41 should be 2.0 Vp-p. The separated signal is then sent to IC2200 as Y and C along the main video lines. It should be mentioned that pin 34 also sends the luma signal to IC6000 so that closed captioning (CC) and synchrony information can be extracted from it.

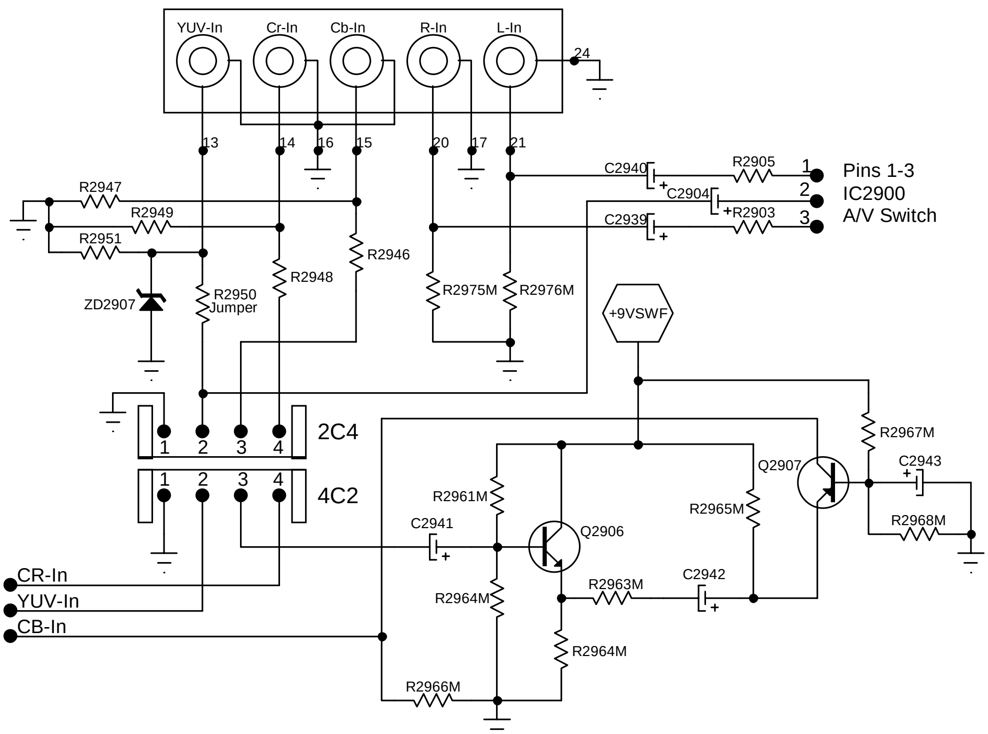
Part Location	Part #	Notes
DL2400	223-00045	IQB27B42W
IC2400	221-01040	IQB27B44W
IC2900	221-01053	All Models

<<*Table CB-4*>>

CB CIRCUIT DESCRIPTIONS

Component Video

Component video is handled differently than the other jackpack inputs. The CB lacks conversion circuitry to make component (YUV) signal into CV. For this reason, component video cannot be used for PiP, which requires CV input, and is furthermore not separated (or combined) into luma and chroma through IC2900. YUV is directly input to IC2200 at pins 37 through 39. This arrangement necessitates the use of a YUV switch from the microprocessor to the video IC. With respect to the A/V switch, however, the Y component is still input to pin 2 and, when in use, is output as composite video to the microprocessor. As mentioned before, this information is used to obtain CC and video synchrony. Moreover, the U component must be amplified to an acceptable level to be used by IC2200. Q2906 and 2907 serve this purpose using the +9VSWF for power.



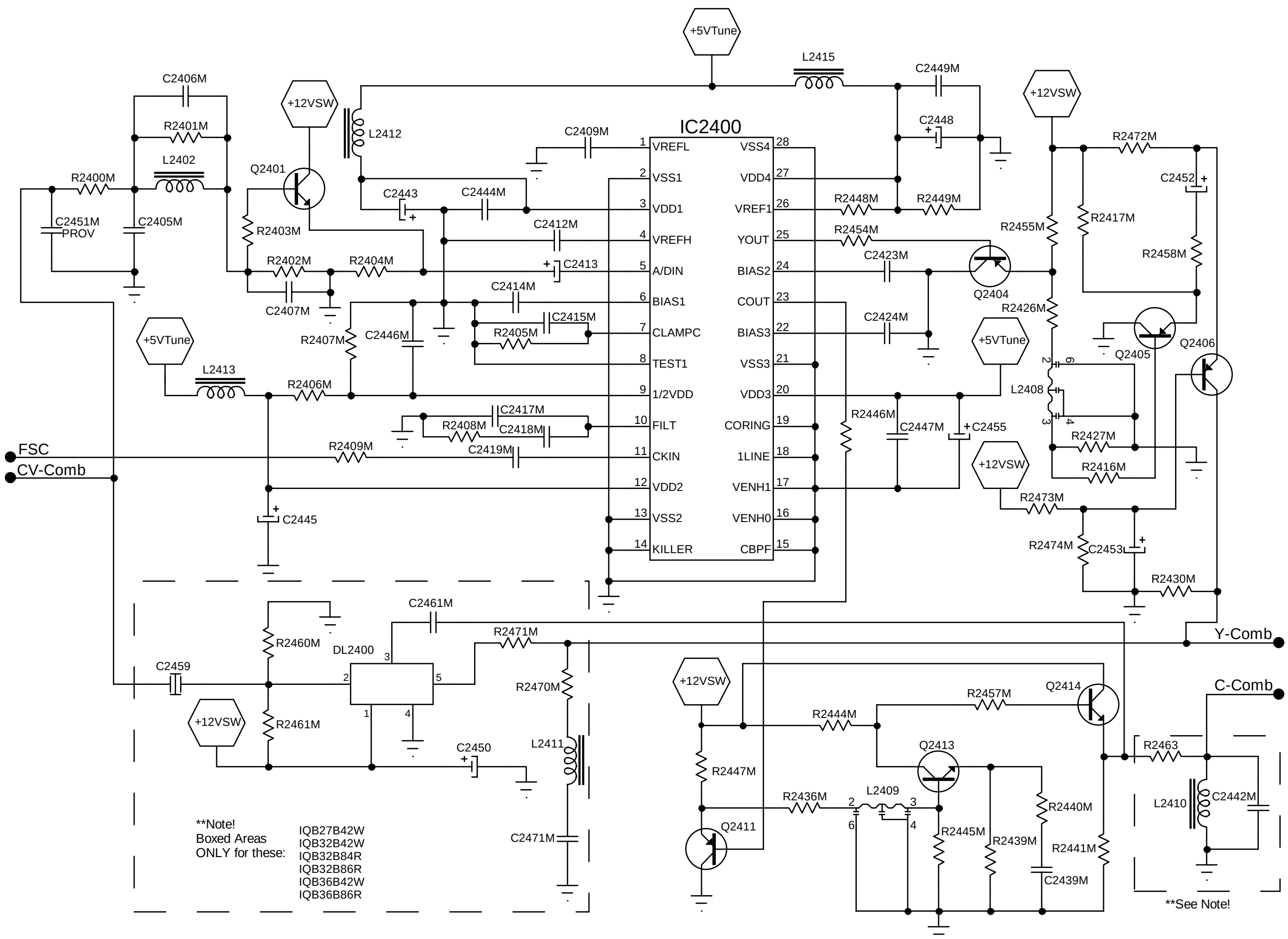
<<*Figure CB-12*>>

Comb Filtering

CB receivers use either a 1H glass comb filter, DL2400, or a 2H digital comb filter, IC2400. Both separate composite video into luma and chroma more efficiently than simple chroma traps and band-pass filters. This allows for video that is relatively free of color and luma distortion in high detail video objects. Comb filters are better equipped to distinguish color from high-frequency luma, and can thereby reduce the crosstalk between the two.

For sets using DL2400, CV from IC2900 enters pin 2. Chroma is output to pin 3 while luma exits the filter at pin 5. Receivers that possess DL2400 still utilize a color trap (R2470M, L2411, and C2471M) and a band-pass filter (R2463, L2410, and C2442M) to ensure purity of both chroma and luma before it is returned to the A/V switch.

On sets using the digital comb filter, CV is fed into an A/D converter at pin 5 of IC2400. This IC is powered by the +5VTune at pins 3, 12, 20, and 27. Output for chroma is at pin 23 and for luma is at pin 25. Both are further cleaned by transistor circuitry that is powered by the +12VSW. Finally, "combed" luma and chroma are returned to the A/V switch.



<<Figure CB-13>>

CB CIRCUIT DESCRIPTIONS

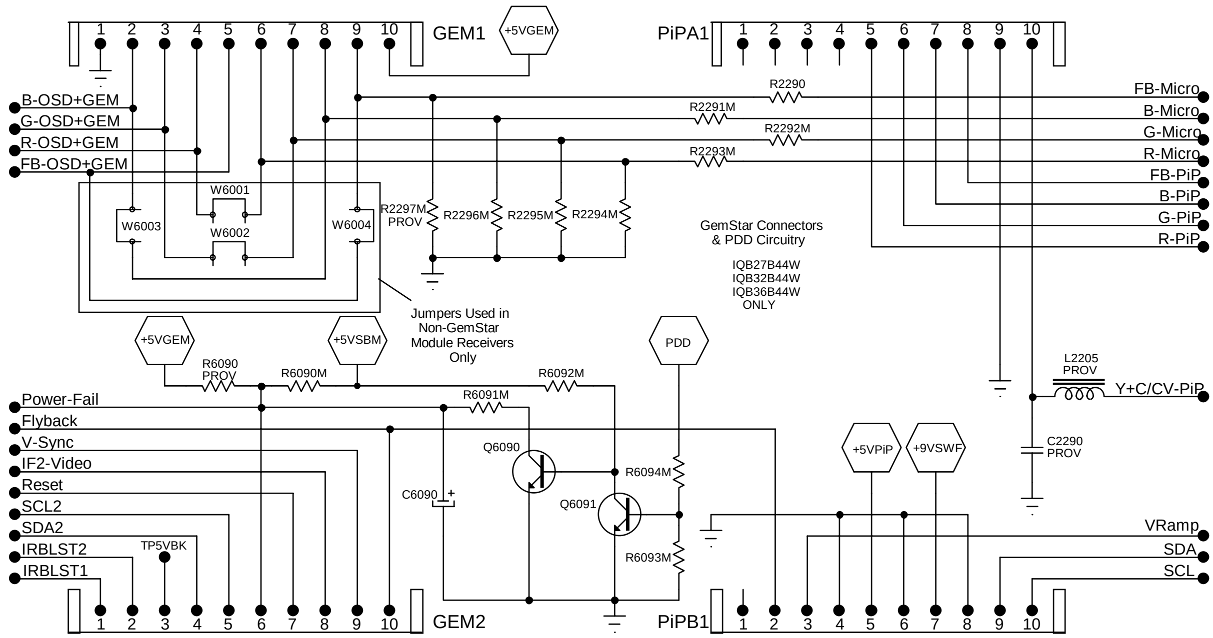
Introduction

The CB chassis video features include two-tuner PiP, comb-filtered video, auto kine bias, half-tone video, and direct component video input to the video processor. Certain receiver models also include 2H digital comb filtering, Gemstar's® Guide Plus, front A/V inputs, and scan velocity modulation.

At the heart of the video circuitry is the NTSC video processor, IC2200. This video IC is powered by the +9VSWF at pins 33 and 44. Its primary means of communication with the microprocessor is via the serial clock and data (I^2C) bus at pins 34 and 35.

Video Development

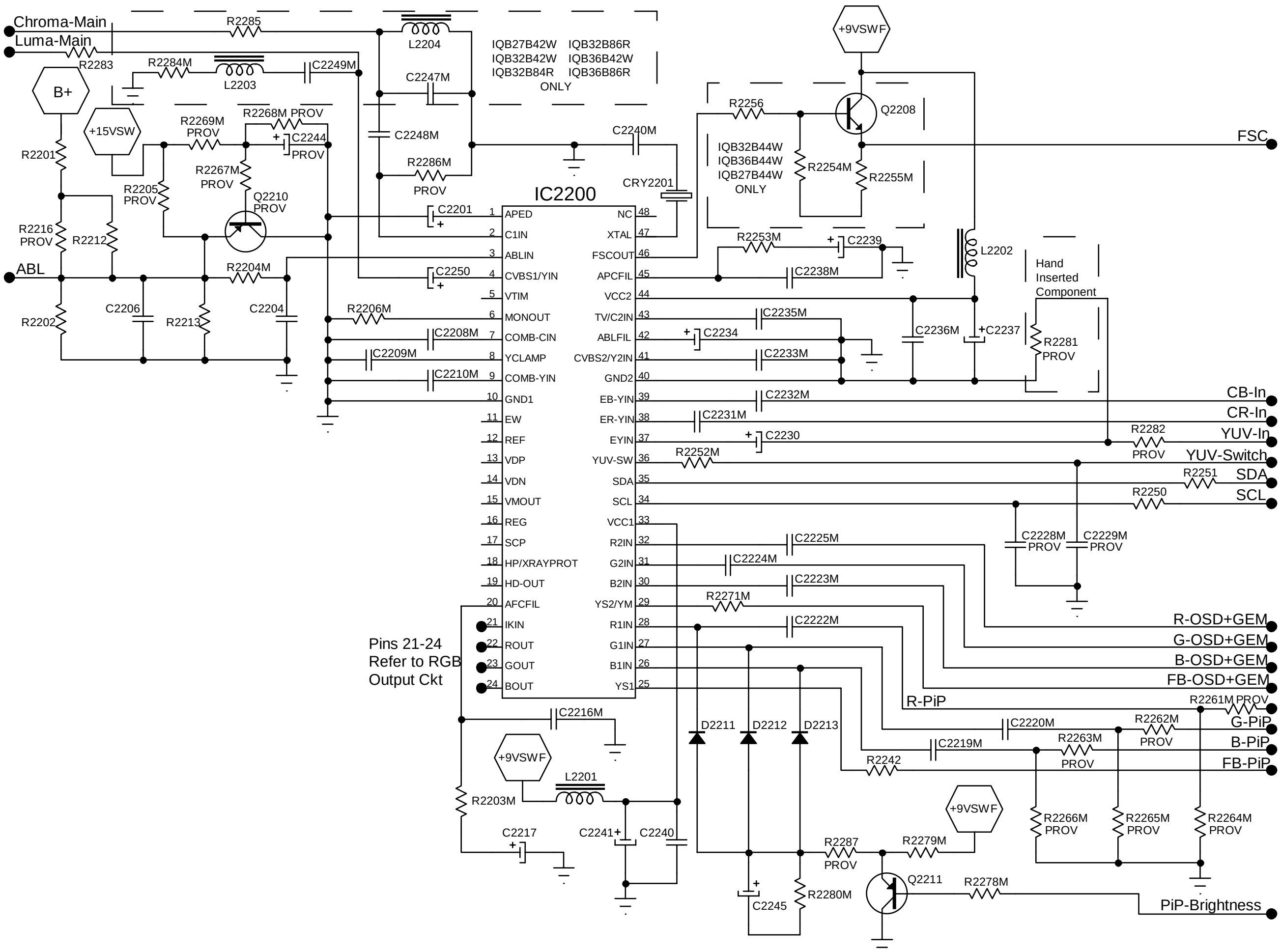
The NTSC video IC handles multiple types of video input and processes the output as RGB (red, green, and blue). Specifically, IC2200 receives luma and chroma (Y/C) information on pins 4 and 2 respectively. This input generally serves as main screen video. However, the video processor's main video input can be switched via pin 36 to use component video (YUV) that is input to pins 37 through 39. Secondary video (PiP) is input to the video processor as RGB through pins 26, 27, and 28. The PiP daughter board receives vertical and horizontal sync information and thereby sends fast-blanking (FB) pulses to pin 25 of IC2200 when main video needs to be blanked for PiP. In this sense, PiP has priority over main video. The micro-processor and, where used, the Gemstar® board also send OSD input as RGB to the video processor into pins 29 through 31 with FB signals from either source entering the video IC at pin 28.



<<Figure CB-14>>

Before video can be completely processed, it must also receive ABL (automatic brightness limiter) and ACL (automatic contrast limiter) information. IC2200 receives this at pin 3. Unlike many receivers, the CB uses a single input to control both ABL and ACL. For simplicity, pin 3 may be referred to as the ABL pin. ABL is first taken from pin 8 of the flyback transformer, TX3204. The signal is made positive across C2206 by the voltage divider formed by R2201, R2212, and R2213. If current level in the picture tube penetrates the

limiter threshold (1.5 mA for 27", otherwise 1.6 mA), the corresponding voltage across C2204 triggers the limiter circuitry internal to IC2200, thus reducing output level (and therefore the contrast and brightness) of the RGB signal. ABL helps to prevent blooming in the sweep that would otherwise occur as high current draw lowers the sweep voltage. It also serves to extend the life of the picture tube.



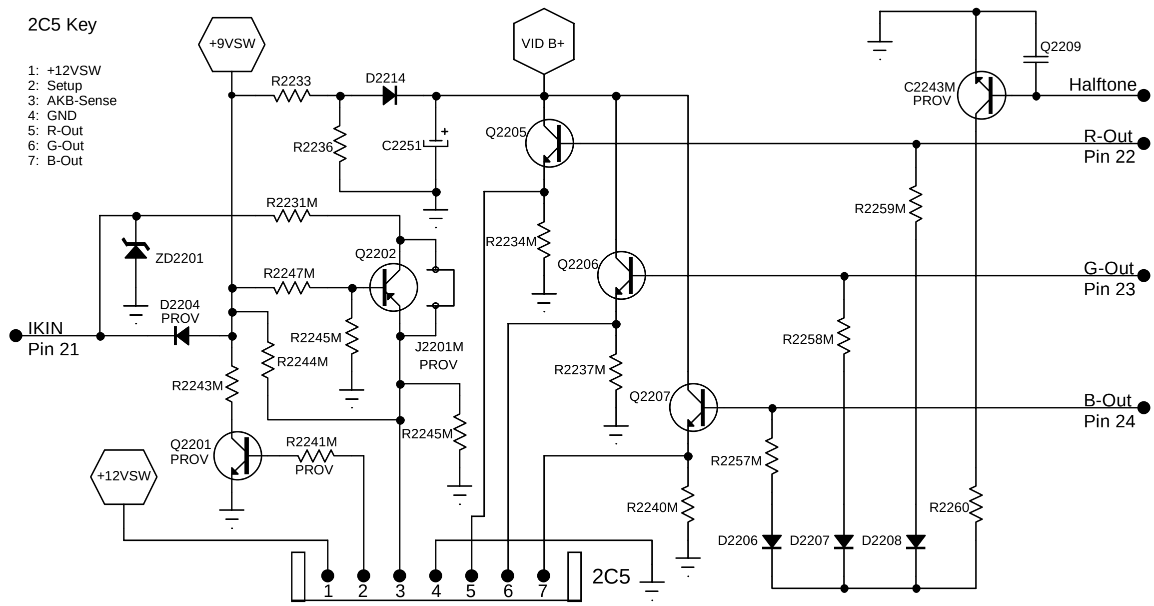
<<Figure CB-15>>

Another factor involved in determining the RGB outputs is the AKB (automatic kine bias) circuit which feeds into IC2200's pin 21. This signal is derived from the CRT circuitry. It uses feedback information developed by three scan lines of video, one per color, in the over-scanned area above the video image. The DC level returned is compared with an internal reference voltage that is determined in the service menu settings for optimum black levels. RGB color is adjusted accordingly and finally output on pins 22 through 24 of the video IC.

IC Location	Part #	Notes
IC2200	221-01394	All Models

<<Table CB-5>>

Before this processed video is pre-driven by transistors Q2205, 2206, and 2207, the video signal can be dimmed by the half-tone circuit. This circuit draws a limited amount of current when Q2209 is switched on by the half-tone pin 40 of IC6000. The half-tone circuit generates a rectangular area surrounding OSD in which video is present but shaded.



<<Figure CB-16>>

Video Amplification

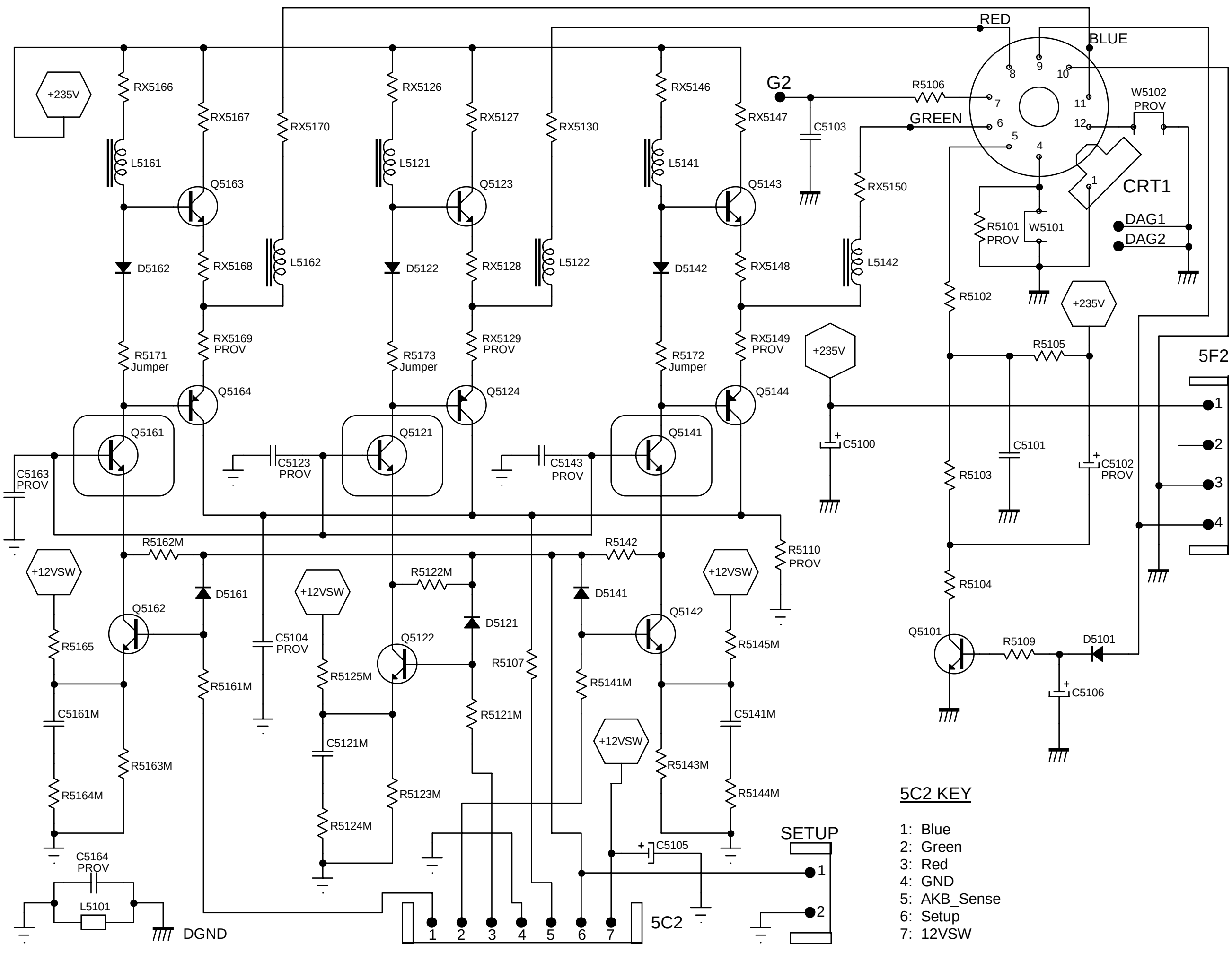
After the RGB signal is pre-driven, it is sent to the CRT socket via connector 2C5. This socket board delivers the filament, focus and G2, and RGB video signals to the picture tube. Besides the AKB circuit, the CRT socket has an afterglow suppression circuit.

Each color is amplified in its own circuit section on the CRT board. The red amplifier section consists of those parts designated with 5120 through 5130. Green uses part designations 5140 through 5150 and blue uses 5160 through 5170. The video signal is cascode-amplified by a dual transistor arrangement for each color. +235 volts from pin 1 of the 5F2 connector supplies power to the cascode amplifiers.

For example, Q5141 and 5142 amplify green signal. Frequency response is the major concern with regard to Q5142. By itself, Q5142 would tend to lose gain at higher frequencies. To remedy this problem, C5141M is added to the series-parallel network on Q5142's emitter. This capacitor along with R5144M provide an improved response to higher frequency signals, while the resistor, R5143M, improves lower frequency response in the cascode amplifier. The resistor network formed here by R5145M and R5143M affect the black level of the green. Q5141 also helps bandwidth of the cascode amplifier. It reduces feedback caused by parasitic capacitance in Q5142. Q5141 has a very low feedback capacitance, less than 3pF, and a nearly 300V collector to emitter breakdown voltage. Its cut-off frequency is about 70 MHz. Its collector passes green signal on to the push-pull coupling amplifier formed by Q5143 and Q5144 and finally to the cathode through CRT1, the actual socket on the picture tube. This example applies to all three color signals, with their respective components substituted.

AKB signal is derived from the collectors of Q5124, 5144, and 5164. These are fed back to the AKB circuit via pin 5 of the 5C2 connector and processed in the manner described above.

The CRT board also features a setup jumper for optimal G2 adjustment. The purpose for it is to force DC voltage on the cathodes to be equal to the CRT cut-off voltage (170-190 volts DC with respect to G1). When jumped, the G2 setup circuitry grounds any incoming video signal. The servicer can then adjust the G2 pot, located on the flyback transformer, TX3204, until retrace lines just start to appear on the screen. Going back to the example of the green circuit, current then flows in Q5141, D5142, L5141, and RX5146. It is at this point that raster is almost cut off. When the jumper is released, the AKB circuit adjusts the color with the highest CRT cut-off voltage to the G2 setup voltage. The other two colors will be just slightly lower depending on their cut-off settings in the service menu.



<<*Figure CB-17*>>

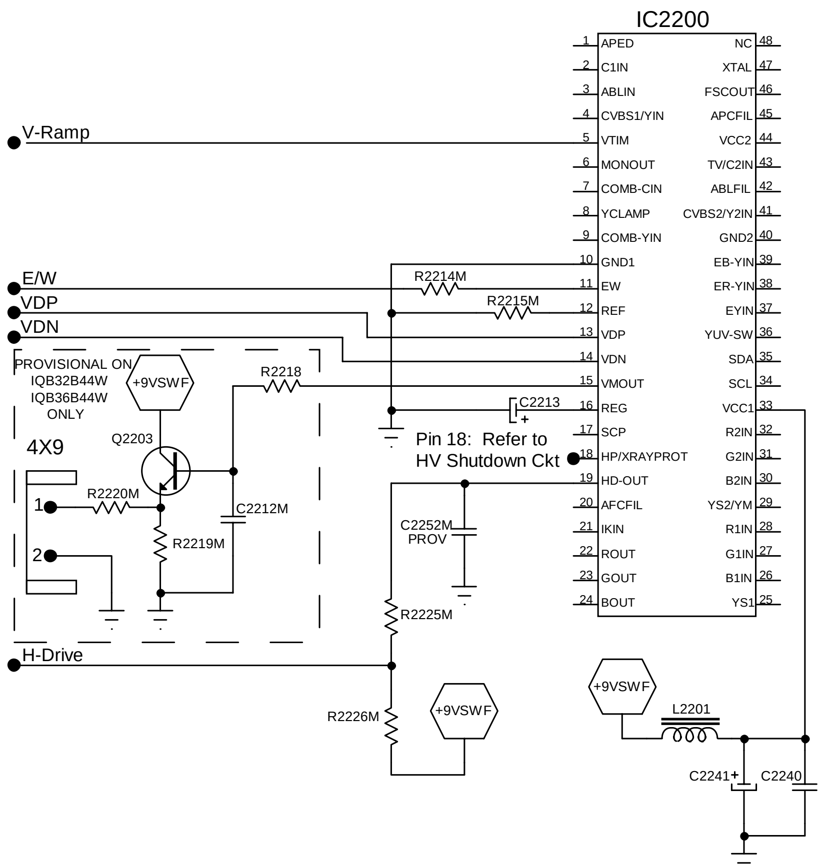
The afterglow suppression circuit is used to prevent any residue light that might otherwise remain on the screen after shutdown. This circuit takes advantage of the fact that the filter capacitor on the +235V line takes a relatively long period of time to discharge. The loss of filament voltage at shutdown triggers the switching of Q5101, which then briefly interrupts the G1's (pin 5) path to ground. The residue voltage on

CB CIRCUIT DESCRIPTIONS

C5101 causes the G1 to become more positive. Since G1 is otherwise considered ground for the CRT, this action reduces any remaining CRT potential, thus eliminating afterglow. C5101 controls the rise time of this circuit, while C5106 controls the dead-time on response.

Deflection Processing

IC2200 also supplies deflection signals to drive the sweep section. Vertical drive is supplied in the form of positive and negative ramp signals on pins 13 and 14 respectively. Simultaneously, a vertical ramp is also supplied from pin 5 of the video processor. This vertical signal is converted into vertical sync, directly by the PiP board, and through transistors Q6002 and 6004, which then provide the v-sync to the microprocessor and the Gemstar® board.

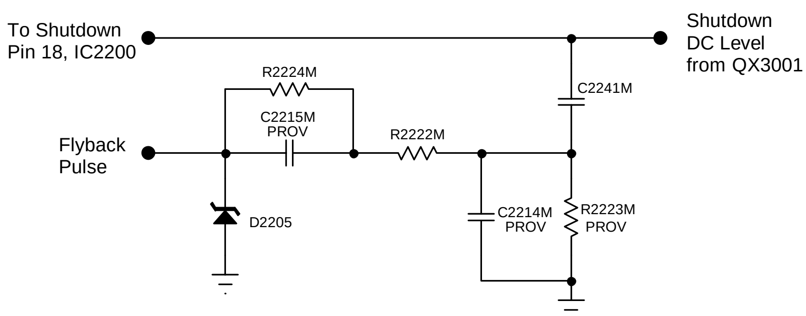


<<Figure CB-18>>

Horizontal drive comes from pin 19 of IC2200. This signal drives the horizontal output transistor (HOT). The flyback line taps off of the HOT collector to provide feedback to pin 18 of the video processor. Furthermore, this same flyback signal provides horizontal sync for the PiP, Gemstar®, and, through Q6001, the microprocessor. Pin 18 of IC2200 also serves the second purpose of protecting the set from high voltage. While pin 18 normally receives horizontal feedback signal, a high voltage situation will activate QX3001. The collector of this transistor will then attenuate that signal. If attenuation lowers the signal to 1.0 Vp-p or below, IC2200 will shutdown the CB receiver. Lastly, in terms of horizontal deflection, pin 11

supplies an E/W pincushion correction signal to IC3200, an op-amp in the deflection circuitry. This signal is calculated by IC2200 to correct horizontal deflection that would otherwise give a "pincushion" appearance due to the geometry of the CRT. IC3200 and its function is further described in the deflection circuit description. Note that it is only used in 32" and 36" CB receivers. Pincushion correction is wound into the deflection yoke on the 27" receivers.

Two CB models, the IQB32B44W and the IQB36B44W, feature scan velocity modulation. Two coils located under the purity magnets on the CRT accomplish scan velocity modulation. These coils are controlled by the scan velocity modulator (SVM) board attached to the back of the CRT near the yoke. The SVM receives fast-blanking and half-tone information from the microprocessor via the 4Q9 connector and video information from pin 15 of IC2200 via the 4X9 connector. These signals are processed to generate a current in the coils. The SVM varies this current to slow beam sweep at color transitions. The effect produces a sharper video image in the CRT.



<<Figure CB-19>>

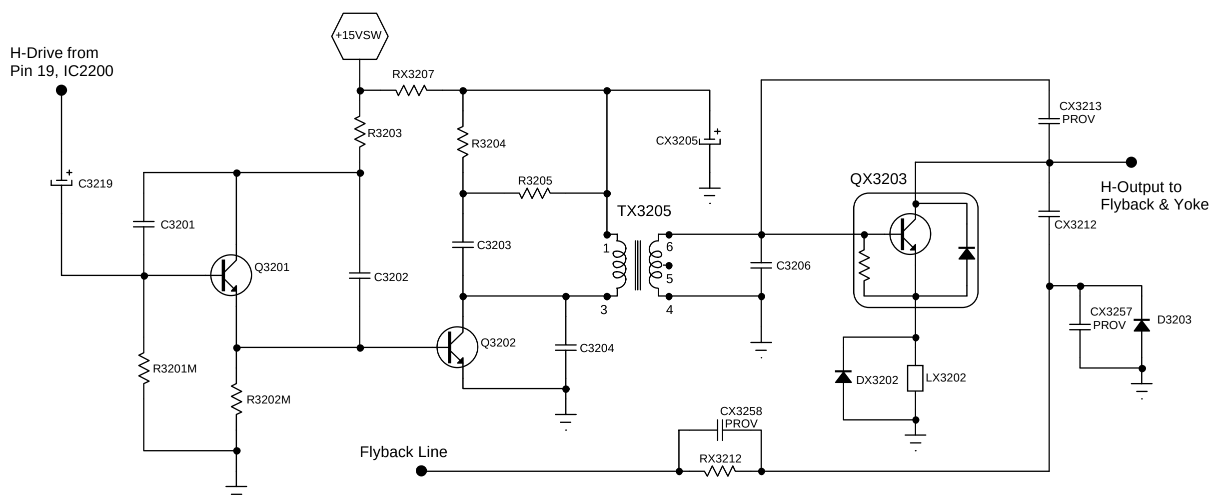
CB CIRCUIT DESCRIPTIONS

Introduction

The CB chassis was developed to support CRTs ranging from 27” to 36”. Major component of the deflection circuitry include IC2100, the vertical output IC; QX3203, the HOT (horizontal output transistor); TX3205, the horizontal drive transformer; and on 32” and 36” sets IC3200, the E/W pincushion correction amplifier. Of course the yoke, connected at 3Y3, and the flyback (or sweep) transformer, TX3204, are major components as well.

Horizontal Drive

Horizontal drive (H-drive) enters the drive amplification circuitry through C3219 into the base of Q3201. This transistor and Q3202 amplify the h-drive using the +15VSW for power. H-drive then passes through the horizontal drive transformer for final wave shaping and voltage to current conversion. This modified horizontal signal drives the HOT, QX3203. The HOT switches current flow in the primary winding of the sweep transformer, TX3204. Regulated B+ is applied at pin 3. Horizontal output also drives the horizontal scan signal in the yoke. Switching frequency of the HOT is 15.734 kHz.



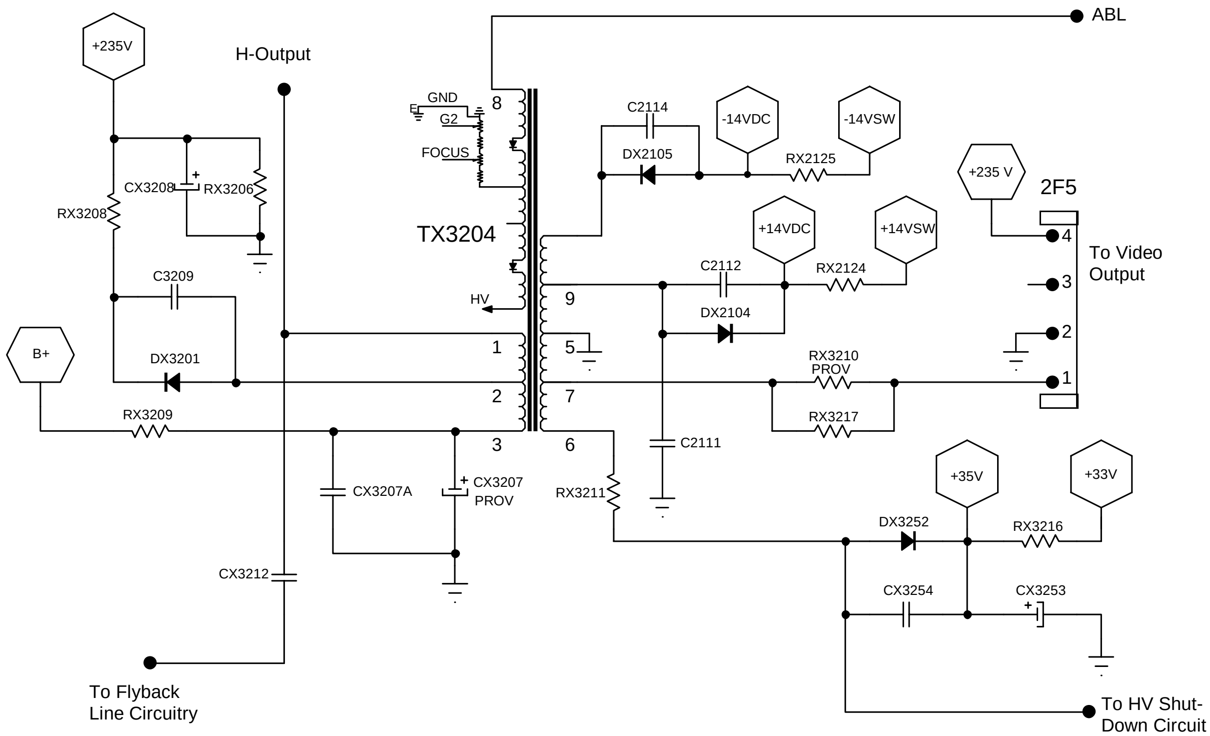
<<Figure CB-20>>

Flyback Transformer

TX3204 uses HOT switching to generate high voltage. For this reason, the sweep transformer is often referred to as the high-voltage (HV) transformer. HV should generally range between 29.4 and 31.2 kV. The flyback does not, however, exclusively develop high voltage. A number of secondary voltages are derived here as well. These should not be confused with the secondary voltages off the chopper, TX3401. The voltages developed off TX3204 are referred to as tertiary voltages in the power supply circuit description.

Pin 2 of the sweep develops the +235V used to drive the cathodes at the CRT socket. This voltage is rectified and smoothed to DC by DX3201 and CX3208 and then applied to pin 4 of the 2F5 connector. Most of the secondary voltages are developed as DC in such a manner with the exception of pin 7’s fila-

ment voltage, which is fed into pin 1 of the 2F5 connector, and pin 8's ABL signal. For the filament's part, since this voltage is needed only to heat the cathodes, it is not necessary that it be a DC voltage. ABL is fed to the video processor in order to regulate beam current.



<<Figure CB-21>>

Pin 6 provides power for the +35V supply previously mentioned. RX3216 drops some of this voltage to +33VSW, which supplies the tuners. Pins 9 and 4 develop, correspondingly, a positive and negative 14VDC. This ±14 volts powers the audio section. RX2125 and RX2124 serve as fusible resistors for the ±14VSW supply to the vertical amplifier, IC2100.

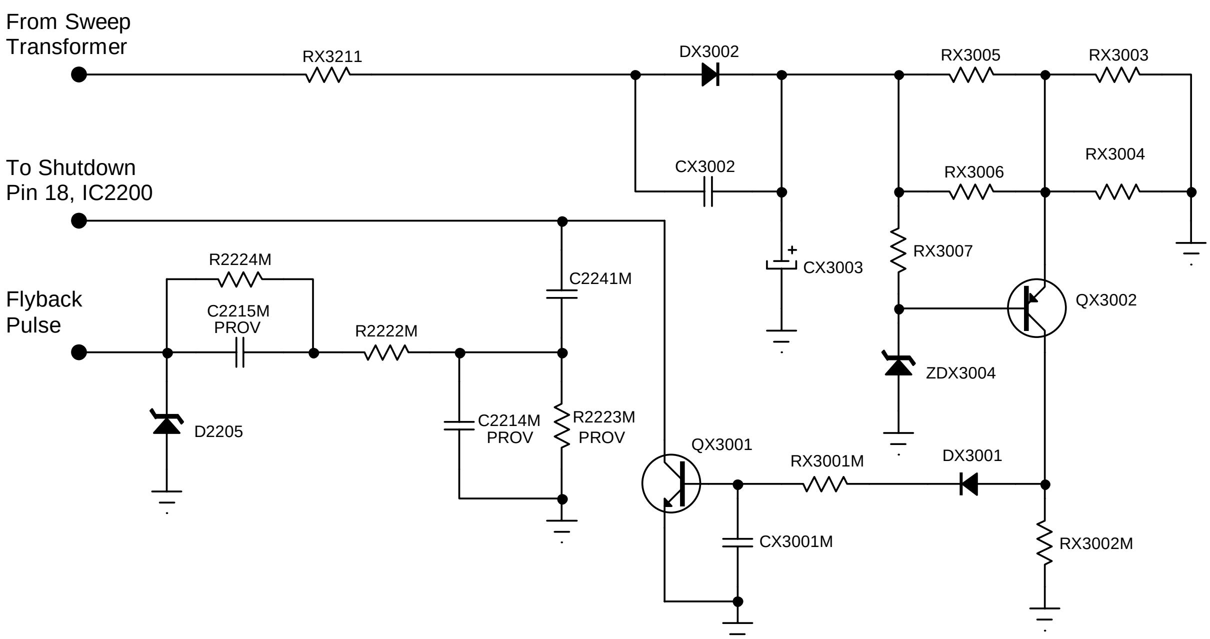
Part Location	Part #	Notes
IC2100	F-53864	All Models
QX3203	F-53367	All Models
TX3204	095-04438-04	All Models

<<Table CB-6>>

CB CIRCUIT DESCRIPTIONS

High Voltage Shutdown

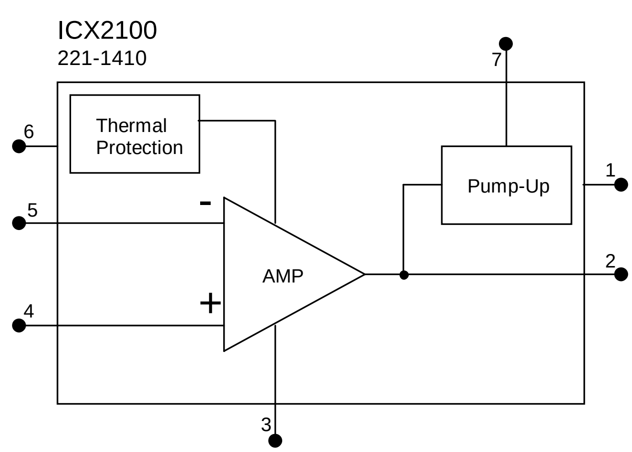
The x-ray protection (high voltage shutdown) circuit uses the current from pin 6. DX3002 and CX3003 convert this current to DC. The resulting voltage is applied to the resistor divider network in the emitter circuit of QX3002. Voltage applied to the base of this transistor remains constant because of the zener diode, ZDX3004. If HV reaches 35.7 kV (33.9 kV for 27" sets) DC applied to the emitter of QX3002 will switch the transistor on. The resulting voltage across RX3002M will switch QX3001 on, attenuating the flyback signal on pin 18 of the video processor. If the signal is reduced to 1 Vp-p or less, IC2200 will cease production of H-drive and thereby shut down the set.



<<*Figure CB-22*>>

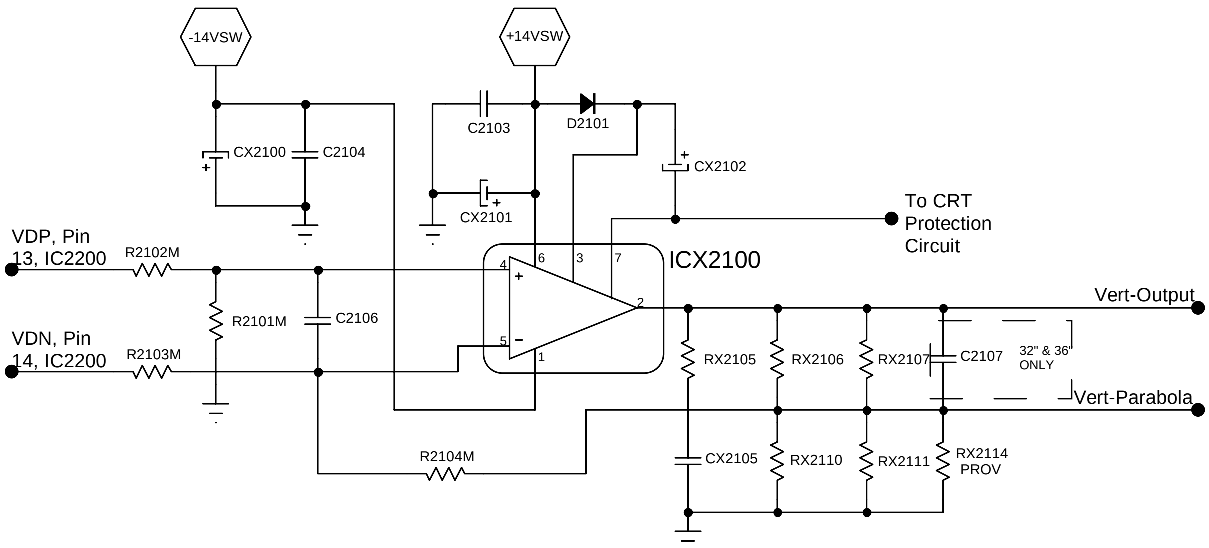
Vertical Amplification

The yoke receives vertical sweep drive from ICX2100, the vertical amplifier. This IC consists of a pump-up stage, a power amplifier, and thermal protection circuitry. The ±14VSW power the IC at pins 1 and 6.



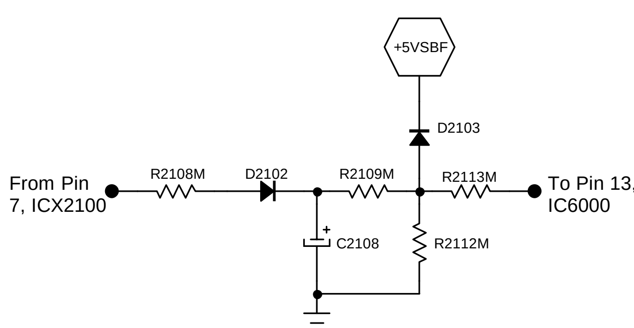
<<*Figure CB-23*>>

Both positive and negative vertical ramp signals are required for operation. IC2200 supplies these to pins 4 and 5 of the amp as non-inverting and inverting input. Pin 3 is an input for output stage VCC. Pin 7 is the pump-up output. Vertical output comes from pin 2 of the amp to pin 4 of the yoke connector. The other end of the yoke provides feedback to pin 5 of the vertical amp and to the horizontal pincushion correction circuit.



<<Figure CB-24>>

The pump-up output from pin 7 feeds the CRT-protection circuitry. This circuitry provides a DC level to pin 13 of IC6000, the microprocessor. The DC level at that pin should be between 3.6 and 5.1 volts. If the voltage deviates from this range, the microprocessor will shutdown the set in 3 seconds. IC6000 will have to be reset before the receiver can be turned on again. The purpose of this circuit is to prevent phosphor burn or worse, the severing of the neck of the CRT. Pump-up current is rectified and smoothed by D2102 and C2108. R2109M and R2112M divide the resulting voltage before it passes through R2113M to the micro. D2103 is a clamping diode.

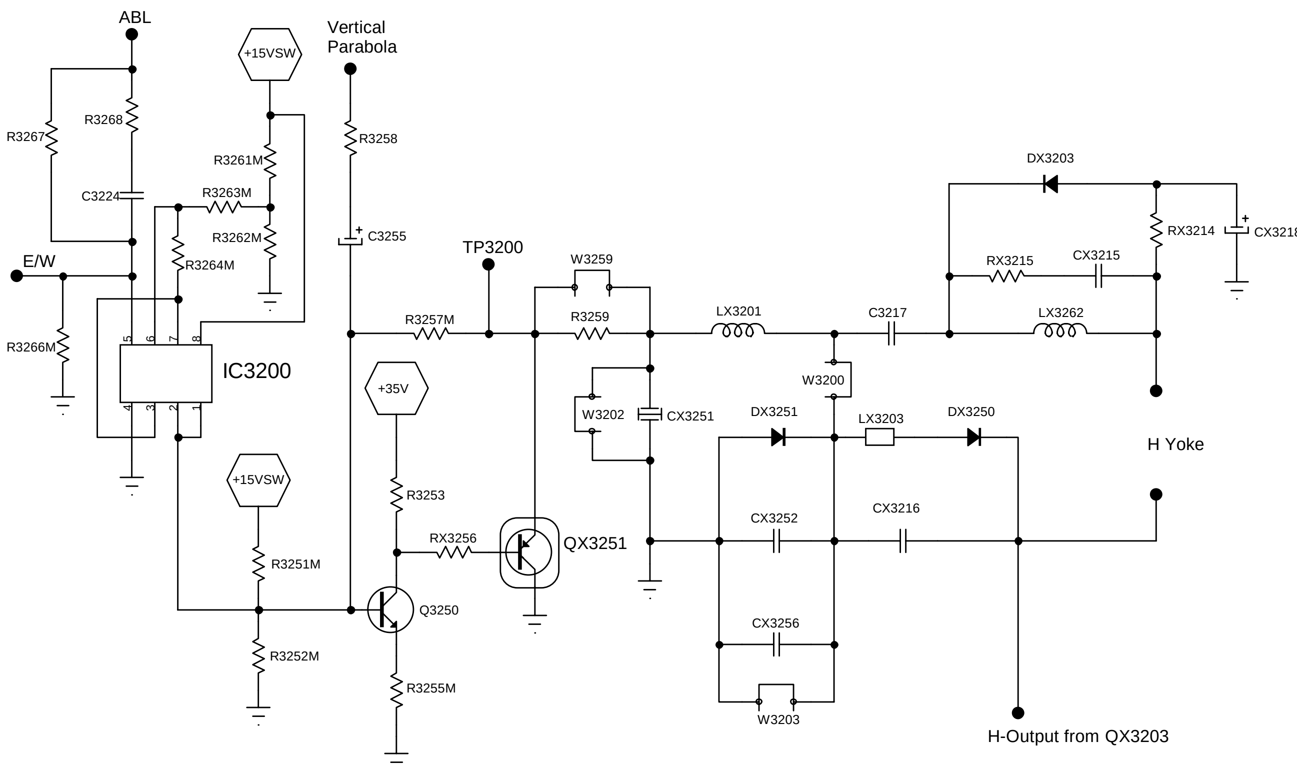


<<Figure CB-25>>

CB CIRCUIT DESCRIPTIONS

Width and Geometry Correction

East/West pincushion correction is performed by circuitry built into 32" and 36" sets. The windings of the yokes used in the 27" CB chassis have this correction shaped into their design at assembly. Correction is necessary on larger sets due to their geometry. As the CRT electron beam approaches the upper and lower extremes of the screen, its horizontal scan lines sweep a wider length than they do in the middle of the screen. DX3250, DX3251, CX3216, CX3252 and CX3256 act as a diode modulator circuit to limit current in the horizontal yoke when the sweep is at the higher and lower edges of the screen. This diode modulator relies on signals amplified by Q3250 and QX3251, and supplied by both the vertical yoke and the video processor. Q3250 receives its power from the +35V derived at CX3253 off the flyback. IC3200 is an op-amp that boosts the signal from IC2200. It is powered by the +15VSW, and provides not only pin-correction information, but also width control. Varying the DC level on the base of Q3250 alters the overall screen width by changing the current through LX3201, the width coil.

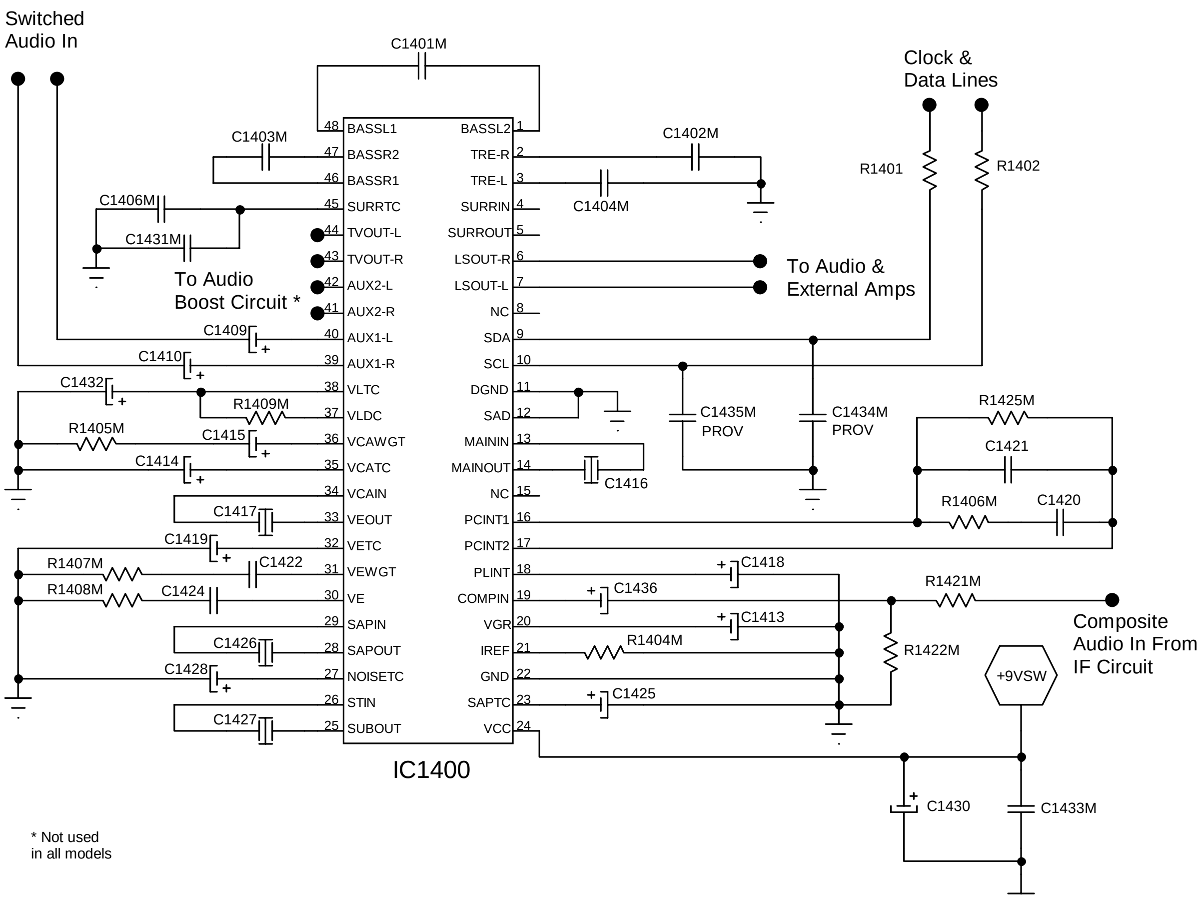


<<*Figure CB-26*>>

Audio Processing

The CB chassis uses IC1400 to process audio. This IC features true MTS (Multi-channel Television Stereo) sound, dbx noise reduction, and SAP (second audio program) processing. Its I^2C bus at pins 9 and 10 allows adjustment for volume, balance, tone control, front surround sound, SAP switching, source selection, and stereo separation. IC1400 is powered by +9VSB at pin 24 and grounded at pins 22 and 11.

CB television receivers make use of at least 2 audio inputs to the audio processor. A third set of inputs is employed on IQBxxB44W type models for audio boost purposes. A description of this process is below. The composite audio comes from a switch in the IF section through C1436 into pin 19. This allows selection of composite audio from either the main or the PiP IF source. Refer to the IF circuit description for an explanation of this switching. IC1400 processes this audio, separating SAP, left, and right audio. The left and right channels are then output on pins 6 and 7. Alternately, the audio processor can use audio input from an external source at pins 39 and 40.



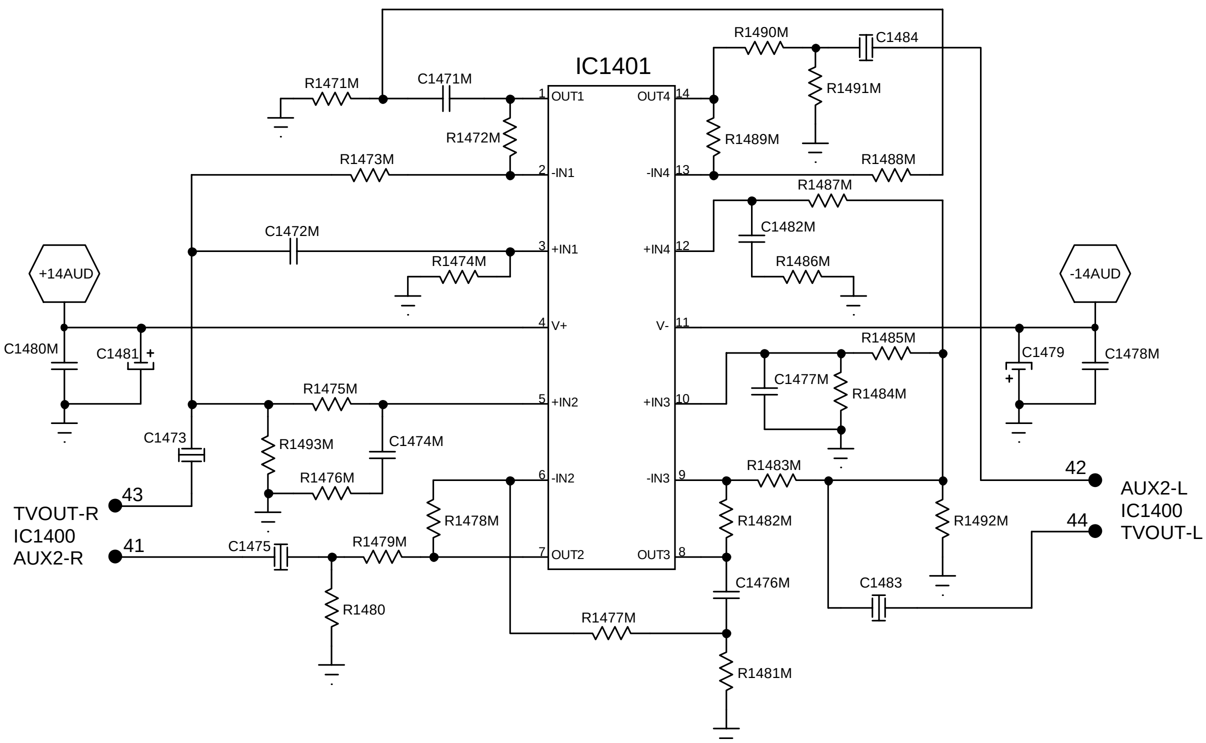
<<*Figure CB-27*>>

All audio input and output pins should meter 4.0 DC volts. Signal at pin 19 should have a strength of 245 mVrms. All other audio inputs and outputs on IC1400 should scope at 490 mVrms. This includes the audio boost I/O described now.

CB CIRCUIT DESCRIPTIONS

Audio Boost

Those sets that have the audio boost feature output audio signal on pins 43 and 44 to IC1401. This IC is powered by the ±14AUD. It strengthens the audio signal and returns it to pins 41 and 42 of the audio processor. From here, the boosted signal is output from IC1400 on pins 6 and 7.



<<Figure CB-28>>

Audio Amplification

CB receivers employ two 8-ohm, 7-Watt speakers. These are driven by IC804, the stereo audio amplifier. Although the audio amp is capable of driving 10-Watt speakers, the supply voltage has been reduced from +36 volts DC to +22 volts. Normal gain of this IC is 42 dB. In order to drive the speakers at 5 Watts, a signal strength of only 50 mVrms is necessary. Such a low strength signal is susceptible to noise interference, so the gain is reduced to 32 dB by negative feedback from the output in order to allow for an increased signal strength of 142 mVrms. R868 and R869 accomplish this reduction for the right channel and R858 and R859 do so for the left channel. The output level from the amplifier is 425 mVrms. Cut-off frequency is 14.3 kHz and is determined for right and left channels by C865M and C855M respectively.

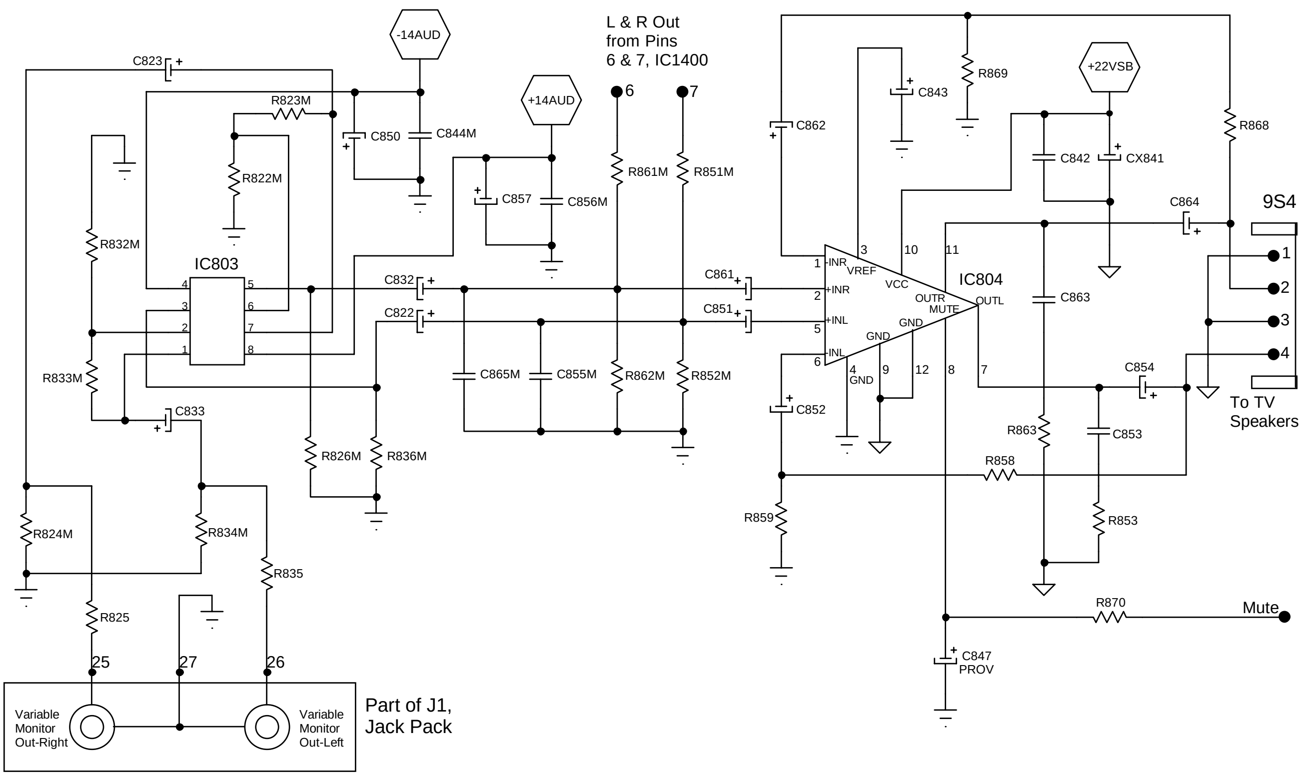
IC Location	Part #	Notes
IC803	221-00170	All Models
IC804	F-53765	All Models
IC1400	221-01127	All Models
IC1401	221-00188	IQB27B44W

<<Table CB-7>>

The +22VSB is supplied to pin 10. Pins 4, 9, and 12 are grounds for the amp. Pins 5 and 2 input left and right (L/R) channel audio fed through C851 and C861, which eliminate any DC accompanying the signal. Pin 3 provides a reference voltage. L/R output comes from pins 7 and 11. Pin 8 is a line that, upon receiving a switching DC level from the micro, mutes the speakers. This occurs when the user selects the speaker cutoff option.

External Audio Output

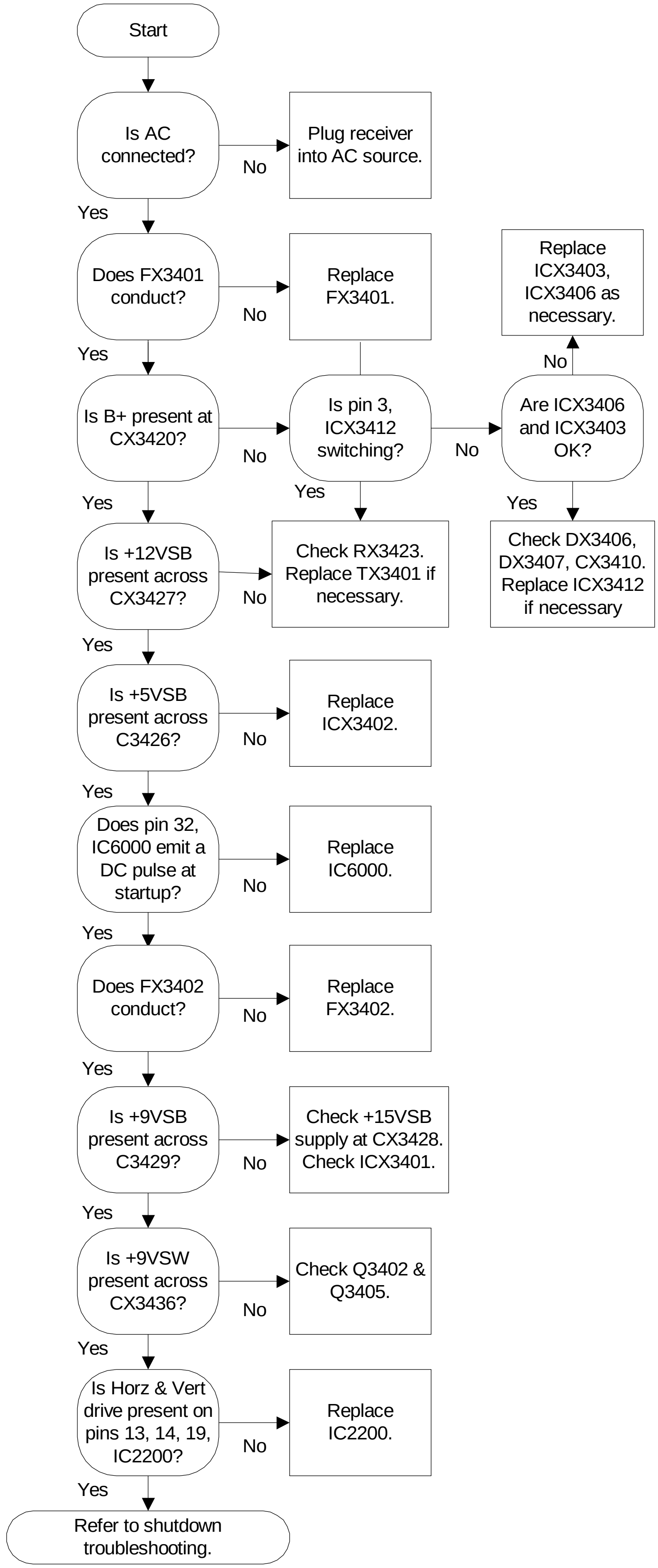
External variable monitor output jacks are included on the CB jack-pack. Their signal is provided by IC803, a dual op-amp that receives L/R from IC1400 into pins 3 and 5. This amp IC is powered by the ±14AUD at pins 8 and 4. Audio output to the variable audio output jacks comes from pins 1 and 7. The op-amp provides a net gain of 12 dB.



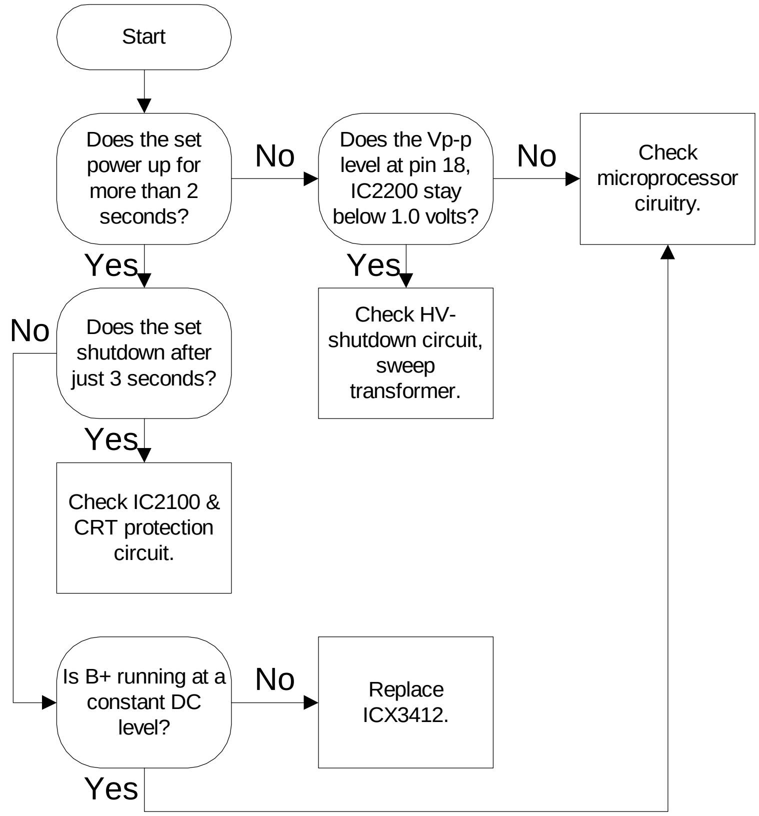
<<Figure CB-29>>

CB TROUBLESHOOTING

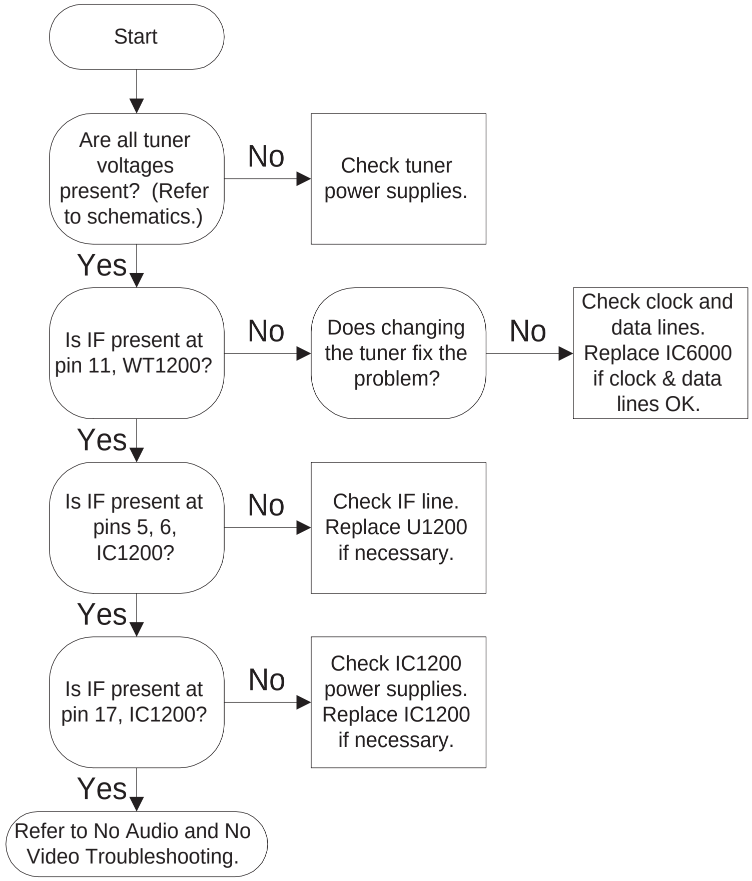
1. No Power



2. Shutdown

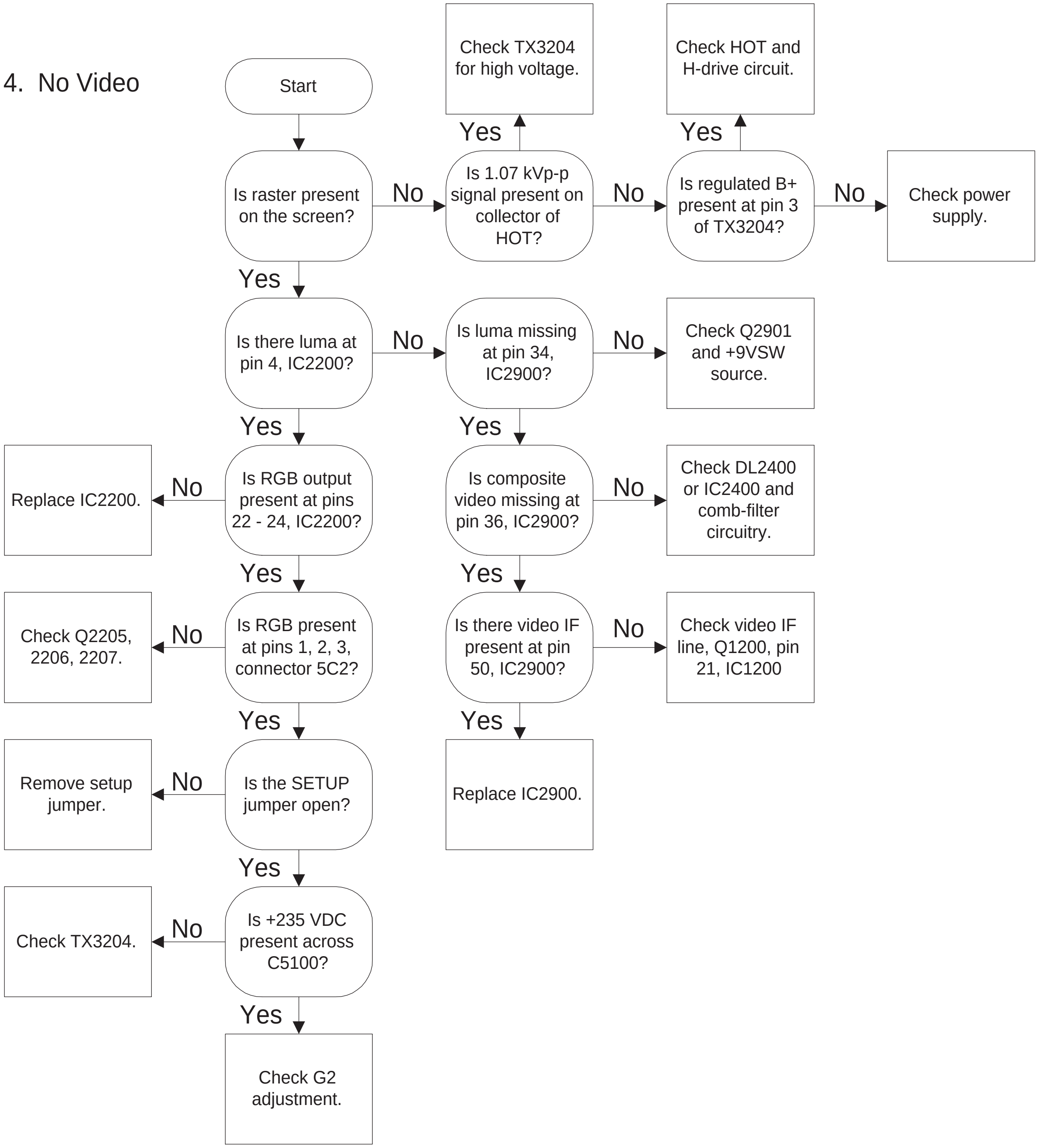

Start
Does the set power up for more than 2 seconds?
No
Does the Vp-p level at pin 18, IC2200 stay below 1.0 volts?
No
Check microprocessor ciruitry.
Yes
Yes
Check HV-shutdown circuit, sweep transformer.
No
Does the set shutdown after just 3 seconds?
Yes
Check IC2100 & CRT protection circuit.
Is B+ running at a constant DC level?
No
Replace ICX3412.
Yes

3. No Tuning

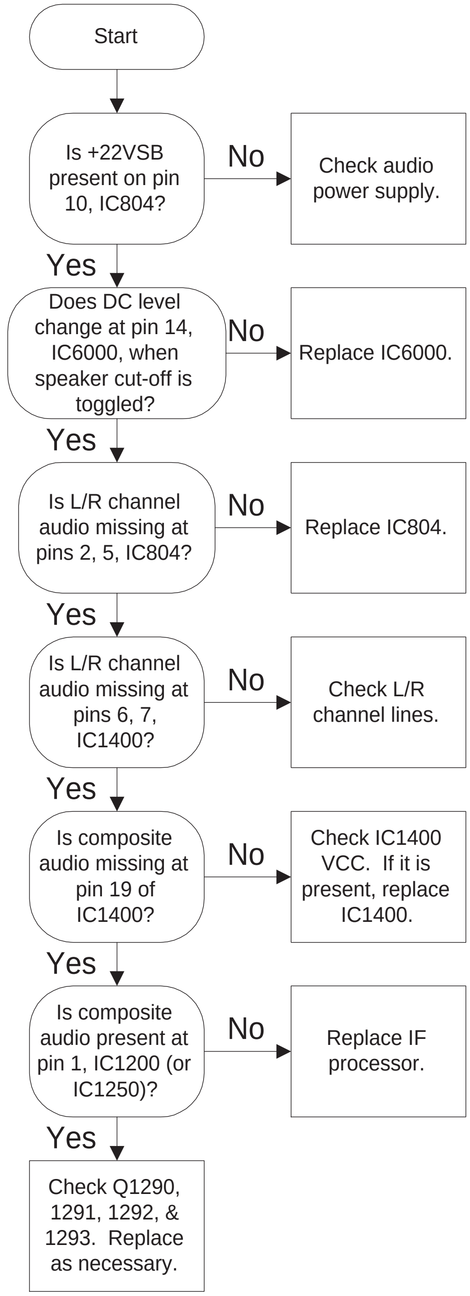


This procedure may be applied to the 2nd tuner section as well.

4. No Video


Start
Is raster present on the screen?
No
Is 1.07 kVp-p signal present on collector of HOT?
Yes
Check TX3204 for high voltage.
No
Is regulated B+ present at pin 3 of TX3204?
Yes
Check HOT and H-drive circuit.
No
Check power supply.
Yes
Is there luma at pin 4, IC2200?
No
Is luma missing at pin 34, IC2900?
No
Check Q2901 and +9VSW source.
Yes
Is composite video missing at pin 36, IC2900?
No
Check DL2400 or IC2400 and comb-filter circuitry.
Yes
Is there video IF present at pin 50, IC2900?
No
Check video IF line, Q1200, pin 21, IC1200
Yes
Replace IC2900.
Yes
Is RGB output present at pins 22 - 24, IC2200?
No
Replace IC2200.
Yes
Is RGB present at pins 1, 2, 3, connector 5C2?
No
Check Q2205, 2206, 2207.
Yes
Is the SETUP jumper open?
No
Remove setup jumper.
Yes
Is +235 VDC present across C5100?
No
Check TX3204.
Yes
Check G2 adjustment.

5. No Audio


Start
Is +22VSB present on pin 10, IC804?
No
Check audio power supply.
Yes
Does DC level change at pin 14, IC6000, when speaker cut-off is toggled?
No
Replace IC6000.
Yes
Is L/R channel audio missing at pins 2, 5, IC804?
No
Replace IC804.
Yes
Is L/R channel audio missing at pins 6, 7, IC1400?
No
Check L/R channel lines.
Yes
Is composite audio missing at pin 19 of IC1400?
No
Check IC1400 VCC. If it is present, replace IC1400.
Yes
Is composite audio present at pin 1, IC1200 (or IC1250)?
No
Replace IF processor.
Yes
Check Q1290, 1291, 1292, & 1293. Replace as necessary.